THE GUN;

OR,

A TREATISE ON

THE

VARIOUS DESCRIPTIONS

OF

SMALL FIRE-ARMS.

BY WILLIAM GREENER,

INVENTOR OF AN IMPROVED METHOD OF FIRING CANNON
BY PERCUSSION, ETC., ECT.

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TESTIMONIAL.

London, Dec. 29, 1834.

SIR,

I lose no time in acknowledging, with many thanks, a handsomely bound copy of your work on *The Gun*, which I have just received, and read attentively from beginning to end; and I have no hesitation in saying that I consider it by far the best work that was ever wrote on the subject. In common justice, therefore, I shall make a point of getting it all the patronage that lies within my humble influence; and I should recommend the perusal of it to every gun-maker, &c. in the united kingdom.

You are at liberty, if you please, to publish this letter.

I am, Sir,

Your humble Servant,

P. HAWKER.

To Mr. Wm. Greener, Gun-maker, Newcastle.

TO

THE MOST NOBLE,

ARTHUR,

DUKE OF WELLINGTON,

PRINCE OF WATERLOO,

ETC. ETC.

THIS HUMBLE ATTEMPT TO IMPROVE THE MANUFACTURE OF

AN ENGINE

WE HAVE LONG BEEN CELEBRATED IN THE USE OF, BOTH

IN THE FIELD AND THE BATTLE PLAIN,

IS RESPECTFULLY

DEDICATED TO YOUR GRACE,

AS A TESTIMONY OF MY ADMIRATION OF YOUR SPLENDID

ABILITIES,

BY YOUR GRACE'S HUMBLE AND DEVOTED SERVANT,

WILLIAM GREENER.

ADVERTISEMENT.

The Author has to apologize to his numerous subscribers for the delay that has occurred in getting out this work. There have been many causes which have tended to delay it, which the Author knew not of, and over which, in fact, he had no control. Publishing is new to him; and he must confess the secrets of the press were entirely unknown to him; and hence his error in announcing the work sooner than it appears it was possible to complete it. The engravings, too, have conduced towards the delay, not from any blame of the artist, but simply from the Author's imagining that all things could be done immediately. One of the plates, he is afraid, is not a good fac-simile, which arose from the difficulty of obtaining a pair of barrels finished, which he could copy as an excellent specimen.

Another subject, and he is done. Should it be objected that the book is too thin for the price, he has only to say that had it been half the thickness, he would not have thought of charging it one farthing less; the immensely expensive scale upon which his experiments have been conducted, have, in a great measure, been ruinous to himself; therefore he trusts, that on a perusal, the reader will say it is well worth the money; and recollect, that he has had no idea of book-making, but simply the benefit of the reader.

Newcastle, December 6th, 1834.

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DIRECTIONS TO THE BINDER.

PREFACE.

THE reader must not expect in this work a display of mathematical knowledge, or of scientific reasoning; he must expect to find in it no learned disquisitions, but simply a series of observations, deduced from a practical knowledge possessed by the author of each subject on which it treats. In endeavouring to establish a conclusion on each subject on which he has ventured to pronounce a decision, he has sought to found that conclusion upon, and deduce it as a necessary consequence flowing from, principles whose truth is universally acknowledged.

The principles of gunnery are but little known to the generality of sportsmen. I do not deny their dexterity in shooting, the precision with which they take their aim, kill their bird, or hit their object, but they have little knowledge of the principle on which the gun is or ought to be constructed. The causes of

accidents they are especially unacquainted with. Those causes are serious enough, God knows; but there is nothing that would so much tend to diminish their number, and, of consequence, to render accidents less frequent, than a knowledge of all those principles, in reference to which the gun is constructed. Those principles the author has, in this work, endeavoured to explain in as simple and popular a manner as his humble abilities would allow; and should his efforts tend to prevent accident, and that criminal sacrifice of human life to the sordid purposes of unjust gain which disgraces the trade, he will be amply repaid for his labours.

There is no one, whose attention has been at all drawn to the subject, who can be ignorant of the enormous extent to which the manufacture of guns of the worst and most wretched quality has been carried on for some years past. If these guns be examined by the eye of a person conversant with the subject, he will perceive there has been a gradual deterioration of the manufacture, and that each new issue is worse than the preceding. What is the consequence of this horrible fraud? The loss of

limb, perhaps of life. I have myself known many men, who, by this cruel, barbarous, and bloody fraud, have been deprived of a hand, frequently of an arm, and I have also known death to be its consequence!

Several causes have concurred to produce the manufacture of this fraudulent and dangerous description. The principal of these causes is the dullness of the gun trade. The termination of the war flung out of employment hundreds who were employed in the manufacture of military weapons in Birmingham. These men now make a living by manufacturing guns of the most rubbishly and dangerous description. Destitute of character—destitute of honesty, they are equally destitute of compunction and remorse. The act of parliament enforcing the proof of guns is of so lax a nature that, instead of offering a bar to the prosecution of their nefarious trade, it is actually in its favour, and operates as an encouragement and protection. One purpose which the Author has had principally in his eye, in the publication of of this work, has been to lay bare—to expose to public detestation, the frauds of the gun-

trade, and by exposing, if possible, to destroy them.

In order to enable the sportsman more easily to detect a fraudulent article, the Author has entered into a pretty full detail of the modes of manufacturing guns, both of the best and of the worst description. He hopes those details will be found sufficiently clear to enable every one who does him the honor to read his work, to discriminate, at a glance, the character of a gun. In these details, he has also entered very fully into the developement of his own views, as to the improvements of which every sort of gun is susceptible.

The Author also describes the present mode of proving guns. That mode meets with his decided disapprobation, for reasons which he has stated, with all the force and clearness of which he is master. He applauds the intentions of the founders of the Proof-House. Nothing can be more admirable—nothing more useful than such an institution. He fully admits its necessity. He only quarrels with the present mode of testing guns, and condemns,

not without suggesting another, that test as useless, because inefficient.

In composing this work, the Author has had to contend with great opposition, from parties interested in the upholding of the present system. It is good, because it benefits them. Everywhere he has found a decided disposition to keep the sportsman in entire ignorance of every thing relating to the manufacture of guns. Even in the trade itself, the Author has discovered a degree of ignorance (which surprised him,) among parties pretending to a high degree of knowledge. This ignorance, coupled with an indisposition, on the part of those possessed of the requisite knowledge, to impart it, (for in all trades there is a fondness for *mystery*, and an indisposition to promulgate the *arcana* of their art,) has been a great obstacle in the way of the Author obtaining accurate information upon subjects not immediately within the province of his own business. If, therefore, there be any incorrectness in the statement which he now publishes, of the various mixtures for irons, that incorrectness is to be attributed to the averseness of

the trade to impart the secrets of their business, and the consequent difficulty which he experienced in discovering the precise proportions of each ingredient in the various mixtures. He is, however, confident, that, save in some points of very trivial importance, the statements which he now submits to the public are substantially correct.

To correctness or elegance of style the Author makes no pretensions. The reader must, therefore, receive with indulgence a composition which is rude and unvarnished in its style. He has had no higher aim than clearness of expression. If he can be understood, his utmost ambition in this respect is satisfied. He has cultivated all sorts of flowers, except the flowers of literature; they never adorned his garden. "THE GUN" has absorbed all his thoughts, and all his labours have been directed to make him master of everything relating to it. To the critic then, he says—lay on lightly; attend more to my subject than my style; to the justness of my observations, than to the composition of my sentences. Grammar and he have ceased to be intimate

since he devoted himself to the vice and anvil, and the sports of the field. He who can detect the flaws in a gun barrel, cannot so readily discern the grammatical errors of a written composition.

Viewing the military arms of England as rude and barbarous, when we consider the many grand improvements that have been introduced into the construction of gunnery within these few years, the Author has probably indulged too freely in his animadversions upon them; but he appeals to those at all acquainted with the subject, whether he has at all exaggerated, when he states the English musket to be unquestionably the rudest gun used in England at this moment. If he has succeeded in pointing out any faults that may be amended, he will feel happy and flattered, that his exertions should in any way have tended to such a result.

The Author can assure the sportsman, that he has made no statement in this work which he has not deduced from many experiments, and of the truth of which those experiments have not

satisfied him. He appeals, then, from their prejudices to their reason, and trusts that they will not reject his statements, if founded in truth, because they may be opposed to their previous conceptions and opinions. It has been said, that this work is calculated to injure the gun-trade. Had the Author such an idea, he would throw his work into the fire. He is satisfied, that it will have a contrary tendency, and by improving, raise the manufacture of English guns to a higher station in the estimation of the world, than they ever before occupied. From this publication, the honest gun-maker has nothing to fear, but every thing to hope. To him he would say, read, and then your opinion. To the hishonest artificer, he would say, there is nothing here for you, but exposure of your frauds and defiance of your malice.

In conclusion, the Author has merely to state, that he has written this work for two reasons. First, because there is no work of the kind, nor has any such work, as far as he knows, ever before been attempted. Slander has already been busy in propagating its malicious surmises,

as to what books he should commit pillage and plagiarisms upon in the compilation of this work, which, of course, was to contain nothing original, but to consist entirely of extracts pilfered from other works. He will save the talkative, malicious old lady any further trouble, by openly revealing to the world the book, the only one from which he ever hoped to derive any assistance—the book of reason, observation, discrimination, and common sense. The second, and more important reason, was, to benefit himself, by honestly attempting to benefit the public.

He now commits his work to the decision of public opinion, knowing that whatever sentence that great tribunal pronounces will be in strict and impartial accordance with its merits.

THE GUN.

CHAPTER I.

ON IRON IN USE FOR MAKING GUN BARRELS.

As the strength of the barrel in guns depends so much on the quality of the iron of which it is made, I shall commence this work by a few observations on the qualities of the various descriptions of iron which are used by our manufacturers. It is a fact, well known, that the iron used at present for the fabrication of the various sorts of hardware, for the manufacture of which this country is celebrated, is of a quality much inferior to that of which the same description of article was made twenty years ago. This has been the result of the progress of science; for by the aid of machinery in conjunction with a superior knowledge of the nature and qualities of iron, our workmen can

employ in the manufacture of goods iron two classes lower in the scale of quality than they could use at any former period. By this means both the cost of the production and the price of the article have been cheapened. So great is the competition in trade, that the manufacturer is obliged to consider not what species of iron is best in quality, but what is cheapest in price; hence it follows that the article returning back in the shape of *scrap*, of which all gun barrel iron is forged, with the exception of the very best kind, is, of course, from its inferiority, unfit to be used in the composition of any gun. By continuing to make the greater part of the guns we manufacture from this inferior iron, we are obviously injuring the estimation in which guns of English manufacture ought to stand.

But, it may be asked, have we not an act of parliament, compelling the *proof* of all guns? We have; but the provisions of the act fall far short of what is required. When I come to the description of the mode of proof, I shall show how defective that mode is.

It appears that at this moment the manufacture of iron for gun barrels is limited to two individuals, Mr. Clive,* of Birmingham, who is, I believe, a very talented individual, and Mr. George Adams, of Wednesbury, who succeeded his ingenious brother in the year 1822, when

* Since dead.

that gentleman was killed by the accidental bursting of the boiler of the steam engine. It was at that period much feared by the trade that the secret of preparing the Damascus iron had perished with him;* but fortunately the present Mr. Adams possessed a sufficient knowledge of the secret to continue to prepare it and other irons with credit to himself, and satisfaction to the trade; and that he may long do so is my sincere wish, as I believe no person understands the nature and manufacture of iron better than he does. In a conversation I had with him a few months ago, I heard him express his regret that the march of what is called improvement, was likely soon to deprive us of the means of obtaining a sufficient quantity of old *horse-nail stubs*, good enough to justify him in continuing to manufacture the iron for our best guns of that description of *scraps;* for, he observed, he could not at that time use the old stubs of this country, because competition was

* Neither this gentleman, nor in fact any Englishman, is entitled to the credit of inventing this mixture, as I find it was first introduced into this country by a letter from the present Lieut.-Col. Bagnold (then a captain in the army in India) to his brother, a captain of marines, in England; which letter was read before the Society of Arts in the year 1819, and for which he received the thanks of that body. Therefore, whatever may be the credit of first manufacturing it, which I believe Mr. Adams was entitled to, (maugre the assertion of any individual, however talented he may be) he cannot claim that of inventing it.

carried so far, that the majority of stubs used in England at this moment are almost entirely made from a description of cast iron called *malleable cast iron.* Half a dozen of these stubs would spoil a whole bloom of iron, by making it so grey, or full of specks, that no barrel-maker could put them off his hands as barrels of the best quality, if forged from iron so manufactured. The same objections apply to the steel required to mix with the stubs. Steel! I imagine I hear one of the old school of gun-makers exclaim, What! steel in a gun barrel! pooh! nonsense! But with all your poohs and nonsense, such is the case, my old boys! and to a great extent too, and an extent that is hourly increasing.

I recollect, a few years ago, describing to a gentleman, the mode of preparing the iron for wire Damascus and stub twist iron, which he seemed to consider rather marvellous; and probably thinking that I had been throwing the hatchet, he hied away, and communicated my information to one of those wise old gentlemen, who, by the help of the Birmingham people, have contrived for forty years to retain the appellation of a gun-maker: "not such a thing, Sir, the man's a fool, an egregious fool; barrels were never made from any thing but iron. Wire twist barrels are all made from wire; Damascus iron is brought from Damascus; and stub twist nothing but old stubs, I assure you." Thus was

I set down for a fool by this old ass; and I have no doubt there are many, too many, like this fellow, and yet these would-be gun-makers will tell you they can make a gun shoot! God knows, it must be by chance, if they do!

But to the steel. It appears nearly the same objections apply to it as to the stubs. For the sake of cheapness we mix a quantity of iron in the fabrication of *coach springs*, [which is the description of old steel preferred,] which, of course, renders them useless for the purposes for which we require them. Hence we are obliged to import this description of steel from the continent at a great cost and trouble. In all probability, then, in a few years, we shall find a difficulty in obtaining either *stubs* or *steel* from that country. For if the Dutch farriers should learn that they can obtain an article either of their own or of foreign manufacture at a cheaper rate, and that will answer their purpose as well as the one they now use, they will adopt it without any consideration of the injury they may do to the manufacture of English gun barrels. The French too, will discontinue the use of *all steel*, if they find that, by adopting the English method they can produce a cheaper material equally adapted for their purpose.

It seems therefore necessary, that we should be either looking out for another market, or turn our attention to the improvement of our mode of manufacturing iron. It has often struck me,

as possible, that iron might be improved by fluxing some other metal with it, that would increase its tenacity and closeness of grain. *Silver* seems to possess the property of uniting with either *steel* or *iron*, though I am not sufficiently acquainted with the subject to give a decided opinion. Of the fact that the best iron of the present day is inferior to the iron that was used for gun barrels twenty years ago, both with respect to its hardness and tenacity, I have not a doubt. There could be no other reason for the modern invention of mixing steel with iron, were it not evident that the modern gun barrel does not equal the old, either in goodness of shooting, or in certainty of standing proof. This is the only conclusion I can come to, that the iron of the present time being found too soft either to stand proof without bulging, or to shoot well, the manufacturer was obliged to mix with it a portion of steel. Even now our barrels do not seem to possess that springy expansive quality so eminently found in all old English or Spanish barrels. I remember seeing at the Proof House in London, a pair of old double barrels, made by the late Henry Nock, and not weighing quite two pounds and a half. They had several holes eaten quite through them with rust. From their peculiar excellence in shooting, the owner had sent them to a gun-maker, to be re-made up. The maker, no doubt wishing for an order for new ones, would have fain persuaded his

customer that they were not safe. He, however, had too good an opinion of their quality to be easily persuaded to dispense with their services. He insisted that they should be proved. They were proved more than once to the severe disappointment and chagrin of the very conscientious gun-maker. They were fit up anew, and I must say I have never seen barrels equal to them since. Very few, I should think, of the barrels of the present day, could stand proof any such weight; not, at any rate, without some improvement in the present mode of manufacture. At that period no iron was used for horse nails, but the very best; now, there is scarcely any used for any purpose, or at least in the manufacture of such articles as have a chance of being converted into gun barrels.

I may be asked, why not use new iron of the best quality? The reply is easy. All new iron possesses a great deal of impurity, which can only be extracted by repeated workings. Hence the preference for horse-nail stubs. They are more wrought than any other article whatever, both in a hot and cold state.

The mania for cheapness is now carried so far, that the furniture of all common guns is entirely made of cast iron. The cock's lock plates, owing to the great improvements in the art of swageing or pressing can now be produced from iron only one degree above the former. These parts of the gun, were they entirely forged by the

hammer, would require iron of the best description. Almost three-fourths of every description of forged hardware goods, which, when worn out or broken, are returned as scraps for the making of iron for barrels of third or fourth rate degree, are now entirely produced from either the malleable cast iron, or very inferior wrought iron. Hence, it must follow, that if the iron masters wish to produce their commonest irons of moderate quality, they must go abroad for it also. The additional evil which this would occasion, would not suit, I fear, those cheap gentry, who are destroying both our internal and export trade, by making guns, which from their want of safety and of the power of shooting, must eventually destroy the reputation which guns of English manufacture now possess, through most if not all parts of the world. As an instance of the villanous way in which guns were once made, I may instance the guns we sent out to Africa when the slave trade was at its height. A gun was generally the commercial article which we exchanged in our horrid barter for slaves. A gun was the price of a man, and what, does my reader think, was the cost of one of these guns? Good God, humanity shudders to think that men could be found so callous to all feeling as to adopt a practice so repugnant to the merciful doctrines of Christianity? Talk of heathen! Where, amidst heathenism, was a nation to be found, that ever

produced monsters, as I may justly call them, so completely dead to all those sentiments of humanity that exalt man above the brute, as our English slave traffickers? Thank God, I trust that stain is for ever washed from our name! Mark, reader, the cost of those guns, for each of which we exchanged a slave, was three half-crowns. For seven shillings and sixpence, we gave these dealers in human flesh stock, lock, and barrel—but such a barrel! I shudder while I write it. As sure as ever it was fired by the poor wretch who had the misfortune to become the owner of it, so sure was he deprived of a hand—frequently of life! The recollection of the many mutilated wretches, the numerous victims to English avarice, which they have seen and do now behold, has made the Africans very cautious about the purchase of our guns. They will not take them without a better guarantee than the word of a dealer. I regret that the same spirit of avarice still exists among our merchants and manufacturers. A vast quantity of guns are manufactured and sent abroad, which, though bearing along with them the character of having been proved, it is well known to any person connected with the trade in Birmingham, that they, or at least some portion of them, have not; and the safety of those that have been, is destroyed by the alteration they undergo after they have received the proof. It is conduct like this that will tend to destroy

our export trade, and if not put a stop to, it will produce serious consequences to all connected with the gun trade.

An idea has often occurred to me, that it would be well if all iron in the bar were submitted to a proof or test. A machine has, (as is well known) in most chain manufactories, been long in use for the purpose of testing chain, both for the purpose of ascertaining if any imperfect weldings exist, and that it be of the requisite strength. I have tried by this machine a number of bars of various qualities, and have been much surprised to find such unequal strength in rods, to all appearance of equal quality. The variation in some instances was as much as 50 per cent. I have also found bars of the common description of iron equal in tenacity to the best. The average strength of each sort shall be stated, when I come to the description of the various kinds of iron. By these experiments I discovered several interesting facts with respect to the tenacity of iron. For example, iron in the state in which it comes from the rolling mill is capable of bearing a certain weight. Heat it red hot, allow it to cool gradually, and it will be found on testing it, to have lost a considerable portion of its strength, varying from seven to fifteen per cent. Again, take two pieces of iron in the rod, and hammer one on an anvil in the cold state for five or ten minutes, and you will find on submitting it to the test, that its tena-

city is increased full ten per cent. in some kinds, and fifteen per cent. in others, over the bar as it came from the rolling mill, thus making a difference of from twenty to thirty per cent. in the quality of the same iron. This is a fact of great importance in the making of barrels, especially in best double barrels, which it is customary to solder together at the breach ends with brass, and which of course can only be done when the barrels are red hot, in which process the strength that is gained by hammering is destroyed by the application of heat. This discovery, to which I unhesitatingly lay claim, (as, I believe, it has never yet been acted upon even by those who arrogate the distinction of being the first gun makers in the world) I shall clearly demonstrate the truth of, in the course of this work.

There is no difficulty attending the testing of the rods. The cost of a machine large enough for this purpose would not be great. The rod of iron, (by means of two pairs of clams, similar in principle to a pair of pliars, on the handles being compressed by the tension of the machine, the grip of the mouth will be sufficiently tight to draw the rod in pieces) might be tested in two minutes. Two men with ease could test thirty in an hour; so that the cost of testing a ton would be but trifling, while the labour and expense would be repaid by the knowledge you would have acquired of the strength and quality of

your materials. Having ascertained the strength of these, you could easily proceed to calculate the strength of barrel of a given weight of iron; you could extend your calculation to the degree of pressure of a certain charge of powder and shot; and having ascertained this, you have the satisfaction of knowing how many pounds to the square inch you have to spare, even with your heaviest charges.

It seems strange to me, that such a desideratum has never been arrived at. I have endeavoured, as far as my abilities would enable me, to give the strength of a barrel of such a weight of iron, and the relative degrees of strength of all the different kinds. It may be observed, that the act of parliament enforces the proof of guns; and the proof they are subjected to at the Proof-house, is a sufficient guarantee that all guns proved are safe. Those who think so are mistaken. The Proof-house is a valuable institution; but the proof which guns there undergo, affords no decisive proof of the security of the barrel. The barrel may be at the time strong enough to bear the proof, but the proof itself may injure the barrel. It may open out some trifling (at that time) imperfection, which by admitting moisture, will in a few years extend to such a degree as to destroy the security of the barrel. I have seen instances in which common barrels, though perfectly sound, and having stood the test, have burst on the explosion of

the first charge that has been put into them. The reason of this I shall explain, when I describe the mode of proof. At present, the sportsman, though he may be confident of the superior quality of the iron of which it is made has no surety that the gun for which he pays fifty guineas, is one whit more secure than the fisherman's musket, the cost of which is only twenty shillings. Nay, from a variety of causes, the latter may be stronger, and therefore safer than the former. To remedy this the mode of proof must be improved at the company's Proof-houses. If not, let some private gun-maker adopt this plan :—back it out with a hydraulic pump, by which you can prove six inches of the tube at the breech-end up to what you calculate it should bear; the other parts according to their substance. Send out the gun, accompanied by a scale or table, shewing the strength of the barrel, the calculated forces of different charges, and the additional strength to spare; and I will be bound to say, that in a few years no gentleman who values his safety, will be found using a gun of any but of the first-rate quality. I proceed now to describe the method of preparing the various sorts of iron.

CHAPTER II.

ON WIRE-TWIST AND DAMASCUS IRON.

DAMASCUS being a variety or mixture, made from the composition named WIRE-TWIST iron, I shall describe them both in this chapter. The mode of making the bar of wire-twist is this :— Alternate bars of iron and steel are placed on each other in numbers of six each ; they are then forged into one body or bar ; after which, if for the making of wire-twist barrels, they are rolled down into rods of 3-8ths of an inch in breadth, and varying in thickness according to the size of the barrel for which they are wanted ; if for Damascus, invariably 3-8ths of an inch square. When about to be twisted into spirals for barrels, care must be taken that the edges of the steel and iron shall be outermost, so that when the barrel is finished and browned, it shall have the appearance of being welded of pieces the size of wires, the whole length of the barrel. A portion of the rod pickled in sulphuric acid exhibits the following appearance :—

the prominent parts being the steel; the other, the iron.

When about to be converted into Damascus, the rod is heated the whole length, and the two square ends put into the heads, (one of which is a fixture) of a description of lathe, which is worked by a handle similar to a winch. It is then twisted like a rope, or, as Colonel Hawker says, wrung as wet clothes are, until it has from twelve to fourteen complete turns in the inch,

when it presents the above appearance. By this severe twisting, the rod of six feet is shortened to three, doubled in thickness, and made perfectly round. Three of these rods are then placed together, with the inclinations of the twists running in opposite directions. They are then welded into one, and rolled down to a rod eleven-sixteenths of an inch in breadth. Pickled in acid, to eat away the iron, it exhibits the following appearance:—

This iron has long been held in great esteem.

It looks pretty; but certainly does not possess either the strength or tenacity of wire-twist iron. It is well known that the strength of a rope may be destroyed by twisting it too much. So is it with this sort of iron. Iron is best when not twisted at all (I speak of the bar), for it resembles a piece of wood. The strands or fibres running parallel and firmly adhering, add strength to each other; if you twist them, you tear those fibres asunder, and they no longer support each other. So it is with iron.

The objection made to the wire-twist is, that owing to the iron and steel being perfectly separate bodies, running through the whole thickness of the barrel, there is a difficulty in welding them perfectly, and of course there is a danger of its breaking across at any trifling imperfection. This objection is certainly well grounded, as many barrels break in the proving. I have myself seen a very strong barrel indeed broken across the knee, without the slightest difficulty, while to all appearance it was perfectly sound. This is the reason why the manufacturers have ceased to make them, except for the American trade.

It may be said, that the fibres in the Damascus, after being torn asunder, are new welded. True; but could you ever glue the fibres of a piece of wood (twisted in the same way) together again, to make them as strong as before? No: cut several pieces of wood across the grain,

and glue them together; you would not expect, though equal in substance with a piece in which the grains run lengthways, to be of equal strength. In short, I hold a Damascus to be little superior to a common barrel, where the fibres run parallel to the bore. The following experiments with the testing machine, prove the correctness of my opinion :—

A rod of the wire-twist, twelve inches long, (and in describing the result of each experiment, I shall confine myself to rods of that length) by 3-8ths of an inch square, containing one and eleven-sixteenths solid inches, bore a weight of 11,200 lbs. without breaking. A rod of prepared Damascus, eleven-sixteenths of an inch in breadth, by four-sixteenths in thickness, containing two and one-sixteenth inches solid, would only bear 8960 lbs., its tenacity being diminished to the extent of 35 per cent. Thus, while a barrel of five-eighths of an inch bore, containing three-sixteenths of solid metal on each side, or four and thirty-five sixty-fourths solid inches, in six inches of the breach-end, of the wire-twist, would bear a pressure of 5019½ to the inch, which, adding the pressure of the atmosphere of 50 lbs. to the inch, would make 5069½ to the inch of tube, the Damascus, of the same dimensions, will only bear 3292 to the inch. This constitutes a very material difference. But this is not all. In the

preceding chapter I noted the fact, that all sorts of iron lose a portion of their strength by being heated or softened; but I found Damascus suffered more than any other sort of iron excepting the common kinds. For instance, the bar of wire-twist would bear, in the state it came from the rolling mill, 11,200 lbs., but after softening, it would only bear 10,180 lbs., being a diminution of 10 per cent. A bar of Damascus, suspending a weight of 8,940 lbs, when annealed, 7,840 lbs. was the measure of its strength, being a falling off of 12½ per cent. Thus, I trust, I have clearly shewn, that whatever other quality Damascus possesses, strength is not one of its properties. It must not, however, be supposed that the above weight indicates its greatest strength: on the contrary, its strength can be increased full 12½ per cent. by cold hammering. Still, however, it will only hold its relative position to other irons with respect to strength, for they are all capable of having their strength increased by the same process.

When the rods are twisted into spirals, they

PLATE I.

DAMASCUS BARRELS.

M[r] WISWOULDS IRON BARRELS.

Engraved by W.

will have the appearance represented at the foot of the preceding page.

When the barrels are finished and browned, the copperplate facing this page will easily enable the observer to recognize them.

CHAPTER III.

MR. WISWOULD'S IRON.

THIS is a mixture of steel and iron, invented by Mr. Wiswould,* of Birmingham; but as he wishes the method of making it to be kept secret, I cannot say more than that its composition is three-fourths steel, and one-fourth iron; and that, like the Damascus, it is twisted in the rod, but not to the same extent, not having more than from four to five twists in the inch. Two of these twisted rods are welded together, with the grain of the metal running in an angular direction, as represented below:—

The construction of these rods confirms me in

* The Persians have a method of making a mixture similar to this, which is described in the paper before mentioned, by Colonel Bagnold.

the opinion that iron is much better not twisted at all. I could not obtain an untwisted rod to subject it to experiment; but I am satisfied it would be a very tenacious iron, were the twisting in the rod omitted. I never saw any iron with which I have been more pleased, both for its clearness, and the beautiful way in which the steel and iron are mixed. In its present state it is certainly not stronger than even the Damascus. The rod of thirteen-sixteenths of an inch in breadth, by four-sixteenths of an inch in thickness, containing two and seven-sixteenths solid inches, was equal in strength to 10,080 lbs. consequently a barrel of the above size would bear a pressure of 3,034 lbs. to the inch of tube. The injury by softening is not to the extent of either wire-twist or Damascus, being only 7½ per cent., which is no doubt owing to the great quantity of steel in its composition, which is not so liable as iron to relax from the closeness of its pores. I certainly think the greater the quantity of steel in the construction of the barrel, the better it will shoot, as the expansion is of course less, and the quickness of the re-action will add increased velocity to the projectile. I never met with a pair of barrels the shooting of which pleased me better than a pair that were made of this iron. They were bored perfectly cylindrical; yet they were superior to all that I tried them against, and to some that were relieved

behind, and that possessed a considerable reputation. I refer my readers to the drawing of a pair of barrels finished, which accompanies the Damascus on the plate; and that below, for their appearance previous to being welded.

CHAPTER IV.

STUB-TWIST IRON.

OLD horse-nail stubs have, for a great number of years, been considered the best kind of scraps for the purpose of making the best gun barrels. Numerous attempts have been made to find a composition of scraps to equal it, but as yet without success. When the practice of using old stubs was adopted, we have no certain date. From the appearance of the oldest barrels, I should venture to say that it was coeval with their invention. It requires, however, no gift of prophecy to say that their use will not long continue, from the difficulty of obtaining them good; being only now to be procured from the continent, and that with increasing difficulty.

Before proceeding to manufacture them into iron, women are employed to sort and examine each stub, to see that no malleable cast iron nails, or other impurities, are mixed with them. They are then taken and put into a drum resembling a barrel churn, through the centre of which passes a shaft, that is attached

to the steam engine which works the rolling mill, bellows, &c. When the machine is set agoing, the stubs are rolled and tumbled over each other to such a degree, that the friction completely cleanses them of all rust, and they come forth with the brightness of silver. The steel with which they are mixed (being generally coach springs) after being separated and softened, is clipped into small pieces, corresponding in size to the stubs, by a pair of large shears, worked by steam. These pieces are then, like the stubs, put into the drum, in order to be divested of any rust they may retain, and are subsequently weighed out in the proportion of 25 lbs. of stubs to 15 of steel, in quantities of 42 lbs. After being properly mixed together, they are put into an air furnace and heated to a state of fusion, in which state they are stirred up by a bar of the same mixture of iron and steel, until by their adhesion they form a ball of apparently melting metal. During this process the bar has become sufficiently heated to attach itself to the burning mass, technically called a bloom of iron, and by its aid the whole is removed from the furnace to the forge hammer, by which it is reduced down to a bar of iron, now about 40 lbs., the weight lost being wasted in the process of welding and hammering. From the forge it passes to the rolling mill, where it is reduced to the size wanted. By this mode of manufacturing, the iron and steel are so in-

timately united and blended, that the peculiar properties of each are imparted to every portion of the mass, and the whole receives the degree of hardness and softness required. The process is admirable, and the mixture is calculated to produce a metal the best fitted under the circumstances to answer the purpose of manufacturing gun barrels of the best description.

The only improvement, if I may take the liberty of suggesting one, is the addition of a larger portion of steel,—I should say at least one half—or at most two thirds. This addition would destroy the tendency which this metal, as at present manufactured, has to bulge, and at the same time impart to it additional strength. By experiment I find that it is weaker than wire-twist, which can only arise from the larger portion of steel in the latter. I admit that this is a disadvantage, yet it is counterbalanced by the excellence of its other properties; still, if we could give it additional strength, an advantage would be gained, which ought not to be overlooked. The principal superiority this iron possesses over the wire-twist, is owing to the steel and iron, when welded into a barrel, being reduced by the action of the hammer and rolling mill, into threads of so minute and fine a texture, and so elongated, that I can compare a bar of this mixture to nothing better than the strands of hemp in a rope; there being only this difference, the

parts of one are separate, those of the other are as it were glued into one, though yet a multitude of distinct layers, varying in size, may be observed throughout.

The above wood cut will give the reader some idea of its appearance, when pickled in acid.

Many attempts have been made to make barrels entirely of steel: these have frequently failed from its hardness. It is not sufficiently tenacious of itself, from its fineness of grain, to resist the sudden explosion of gun powder. But where the attempt has been successful to obtain a barrel that would bear proof, its powers of shooting have been found to be very great. Hence it is proved, that to make a barrel shoot well, it must possess hardness. In this direction then we may advance, with a certainty of improving our guns, provided we do not pass that limit, yet to be ascertained, which safety requires. It was the knowledge of this fact, that first induced the iron masters to introduce steel into the composition of their iron. The most complete success attended its introduction. Others have attempted to introduce a tube or lining of steel into an iron barrel. Half an hour's consideration ought to

have been enough to discover that this experiment would fail. It is well known that bodies of different temperatures will not spring together. For instance, let any one encase the best shooting barrel that ever was made, with a covering of lead, sufficiently tight to allow no space between, and then fire that barrel, and he will find its shooting properties gone. Remove the lead, and they return. Thus it is with the iron: it acts as a casing of lead to the steel. The two cannot act together—the power of expansion is destroyed. The union, however, of steel with iron, in the mixture I have just described, is liable to none of these objections, for the two are so intimately blended together, and perfectly incorporated, that they act as one substance, possessing at once the hardness of steel, with the soft tenacity of iron.

The testing of the bar shewed the strength to be as follows:—6-16ths broad, by 5-16ths thick, containing 13-32 solid inches of iron, would stand a tension of 8,960 lbs. So that it necessarily follows, that a barrel of the same dimensions as the Damascus, would stand an internal force of 4,818 lbs. to the inch of tube. The loss of strength by softening is about seven and a half per cent., no doubt to be attributed to the way in which the steel and iron are mixed.

The rods are generally of the above dimensions, though of course varying in thickness, to suit the different sizes and parts of barrels, so

that in six inches you have as many as sixteen spirals, and consequently that number of weldings, as is shewn in the

above cut, which gives a great addition of strength, as there can be no doubt that a perfect weld is stronger than the same thickness of solid iron, with the grain running parallel. Another advantage attending small rods is, that in the rolling a greater pressure is obtained, and the pores of the iron are more compressed. I have found that small or thin rods are invariably stronger in proportion than rods of the same iron of greater bulk. For example—fore part iron of about two thirds the substance of back or breach end part, being invariably within a mere trifle as strong.

All twist barrels are denominated stub-twist barrels by most dealers. I need scarcely inform the reader that a very small proportion of them are really so. They are principally made of the next description of iron, which has been inaptly styled counterfeit stubs. There is only one method in which a gentleman can be sure of

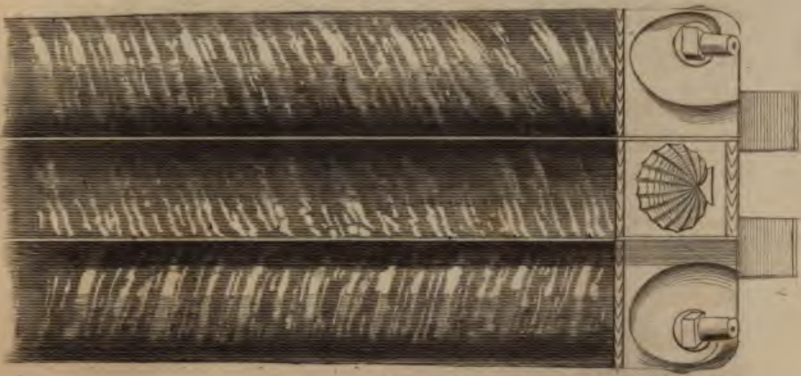
obtaining barrels made of genuine stub-twist. Require the gun-maker to stain them with the smoke brown (a modern invention of staining, the description of which will be found in the proper place), and he will not be able to accomplish it, if the barrel be not genuine; nothing is easier, if they be really made of stubs twisted. The cause is this. Hydrogen gas acts only on iron; steel resists its action; so that when a barrel is properly finished, the steel remains quite bright, while the iron has become a beautiful jet black, which will be easily recognized by attention to the appearance depicted in the representation opposite.

The reason why barrels of this iron are so rarely to be met with in the country, is the cost. No barrel maker can or will forward them to the country, at the price they are accustomed to receive—they prefer the practising of a deception upon their customers, upon whom they palm barrels of the next quality of iron, and having persuaded them that these are the real Simon Pures, they quietly put the difference of price into their own pockets. This deception they can easily practise, as even very few country gun-makers are able to detect the fraud. By the old way of browning, detection is rendered almost impossible, as the impostor frequently appears the finest twist of the two.

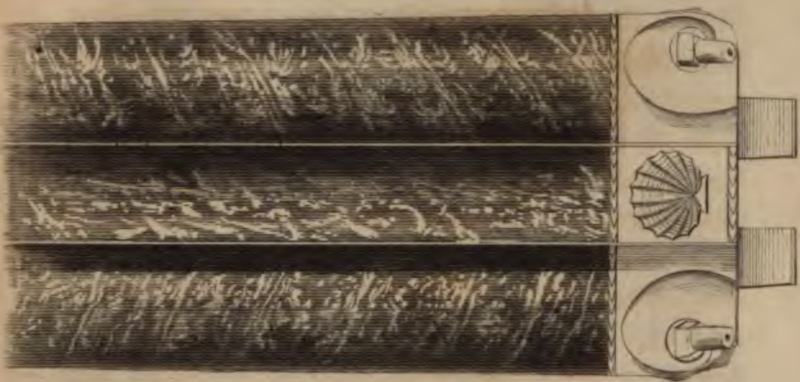
CHAPTER V.

STUB DAMASCUS.

This is a beautiful mixture made from the stub iron by twisting it in the same way as wire twist is made during its conversion into Damascus. The objections which I have adduced against the mode of preparing that iron, apply with equal force to this. The appearance, however, is very beautiful, and it is admirably adapted to please cockney shooters or parlour sportsmen. So splendid is its appearance, that it cannot fail to captivate the eyes of that class of gun-makers' patrons. The appearance is represented in the opposite engraving.



STUB TWIST BARRELS.



STUB DAMASCUS BARRELS.

Engraved by W. Collar

CHAPTER VI.

CHARCOAL IRON.

THIS is the description of iron which is so frequently palmed upon the purchaser for stub-twist, and is the country gun-maker's and hard-wareman's REAL stub-twist. It would be well if they never sold for the genuine stub-twist, iron of a still inferior quality. It is entirely composed of iron, being manufactured principally from the best description of scraps than can be obtained, such as cuttings of hoops, pieces of sheet iron, and various other kinds of good iron. They are all clipped into pieces of the size of stubs, by that useful auxiliary the shears; they are then purified by being whirled about in what termed the drum. After that they are put into a blast furnace heated by charcoal; when heated to a welding heat, they are gathered into a mass and conveyed to the hammer, by which they are reduced into a square bar, and lastly they are rolled into rods of various dimensions as may be wanted, either for legitimate or illegitimate purposes, either as second iron, or imitation

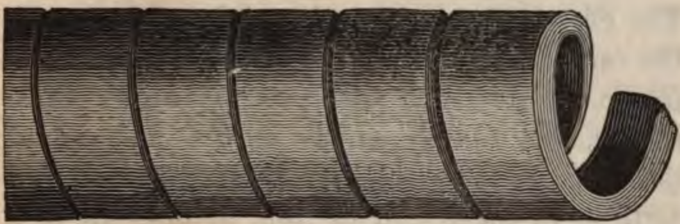
stubs. The intention of welding them in charcoal is, that they may imbibe a certain portion of carbon. This process gives it the appearance of having been mixed with steel, the particles of which are as distinct as in the real stub and steel. This converted iron, however, will not endure the test of browning by smoke, or more properly flame, as the oxygen invariably destroys the appearance of steel in twelve hours after its application. By the old method of staining, it would be as impossible for any man who was not a judge, to point out the real from the counterfeit, as to discern a copy executed by a clever artist from an original painting by one of the old masters. It is decidedly inferior in point of strength to stub, but it is superior to Damascus.

Its greatest strength appears to be as follows: 9-16ths of an inch broad, and 4-16ths thick, containing 1 and 11-16ths of an inch solid, will

bear a weight of 10,080 pounds. So that if my calculations are correct, it will bear only a pressure of 4,526 lbs. to the inch tube. The loss of strength by heating or softening is full 10 per cent.

I have already stated that this iron is very much used in consequence of its cheapness, its

cost being only four-pence per lb, while steel twist costs five-pence. It is also easily worked, being considerably softer than any of the above-described irons.



It has the above appearance when twisted.

I may be asked why so much inferior iron is used, when the difference in the price between the good and the bad is only a penny per lb.? The reason is this. If a barrel filer receives an order for a pair of barrels, having probably deceived his customer before, or, at any rate, knowing that he can deceive him without running any risk of detection, he sends to the welder sufficient charcoal-iron to forge these barrels. Should the quantity amount to 10 lbs., he, of course, saves ten-pence. The welder receives two shillings less for welding this description of iron than for welding stub-twist, so that here is already a saving of 2s. 10d. At the boring mill, and the grinding mill, the charge is also proportionate: the wages of the journeymen are less, so that by imposing on his customer one pair of barrels manufactured of this sort of iron instead of the real stub twist, he pockets a clear fraudu-

lent gain of above 9s.; and should he manufacture one hundred such pair of barrels in the year, it would make at the year's end, no small item in the year's account of gain.

Thus it is with all descriptions of barrels. The charge for making, by each workman, in the various stages of the manufacture, is according to the quality of each pair of barrels. The saving, then, to the man who makes one hundred pair of barrels in the year, though it be but a farthing in the pound of iron, mounts up to a considerable sum. This fraudulent gain of more than 5s. on a pair of pretended stub barrels, is what is called in Birmingham, a nip—biting the yokels—a reward for ingenious knavery. But when they receive orders from what are called general factors, who very kindly supply their country friends at a moderate commission of 40 or 50 per cent., these gentry take care to lap up the cream; for I know from facts that the barrel filer has sometimes scarcely five per cent. for his trouble of overlooking. One consequence naturally results from this, that every species of roguery and deception will be resorted to, in order to indemnify themselves for their labour and trouble. At the present time, I know it to be a fact, there are hundreds of guns made in Birmingham, the barrels of which, in some instances, never see the proof-house, as eight-pence per barrel, the cost of proof, is a great temptation! Besides, a great number of barrels declared

wasters, such as repeatedly bulging in the proof, being full of flaws, having holes in the sides, or some other fault sufficient to condemn them in the eyes of a moderately conscientious barrel maker, are bought by men who live by this species of fraud, and are repaired with such neatness, putting in pieces artfully, beating down swellings or bulges, and then forging the proof-mark; and, last of all,—mark—as if to crown their duplicity and villany, they fit them up, send them to the engraver when ready for that process, and, by having the names of some living or defunct London gun-maker of respectability engraved upon them, palm them upon some hardwaremen for a good article; and that is not all, for guns thus vamped up and repaired, their defects covered by all the ingenious and fraudulent trickery of art, with forged proof-marks and false names engraved upon them, they find a ready market in many a shop in London, which, if truth were not still a libel, I could easily name.

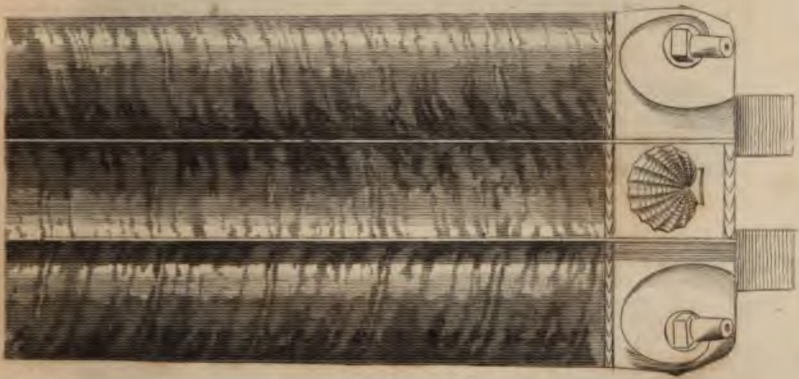
CHAPTER VII.

THREEPENNY SKELP IRON.

An iron also much used in these cheap times. It is composed of scraps of an inferior description to those used for the charcoal iron; yet not very inferior, as there remain two selections after this. The method of preparing them is the same that is practised with stubs. They are cleansed, clipped to an uniform size, (yet not near the size of either of the former) fused or welded in an air furnace, and reduced by the forge and rolling mill to rods averaging 11-16ths of an inch broad, and of various thicknesses.

The strength is as follows :— A bar 11-16ths broad, by 3-16ths thick, containing 1 35-64ths solid inches, bore 7,840 lbs.; consequently, a barrel, as before, will only bear a pressure of

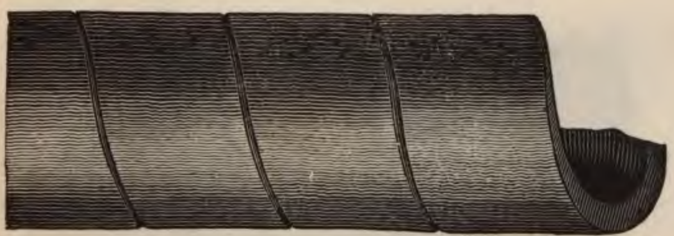
CHARCOAL IRON BARRELS.



THREEPENNY IRON BARRELS.

Engraved by W. Co

of 3,841 lbs. to the inch of tube. This fact should be paid particular attention to, as a marked decrease of strength is shewn here. Nor will that decrease of strength be remedied by increasing the quantity of metal. Rods of the same breadth, 4-16ths of an inch thick, would not bear a proportion of 45 per cent. Besides, this iron loses in tension at least 15 per cent. by being softened, though its strength will increase nearly in the same proportion by cold hammering. This is occasioned in a great degree by the openness of the pores of all common irons, and consequently, by compression you increase their strength in proportion more than you can that of irons of a finer quality. Barrels made of this iron may easily be recognised by observing the accompanying wood-cut:—



It will be seen that the spirals have much more of the cork-screw twist; owing to the breadth of the rods, which requires more inclination. They require to be considerably heavier, and are generally so; though, as I mentioned, weight and strength do not in this iron keep

pace with each other. This is owing probably to a difficulty of hammer-hardening a barrel of large dimensions, without we had hammers of a greater weight, which cannot be expected, considering the price the poor welder has for welding them. That price does not exceed five shillings per pair; much too little to do them well.

An immensity of guns are made of this iron for the pawn-broking trade, as well as hardwaremen, &c. Single guns may be purchased even of these retailers, at four or five pounds; double guns at eight or nine.

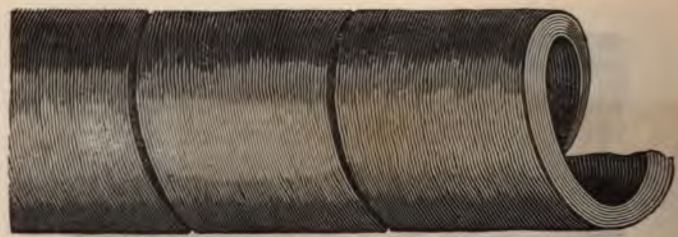
CHAPTER VIII.

TWOPENNY, OR WEDNESBURY SKELP,

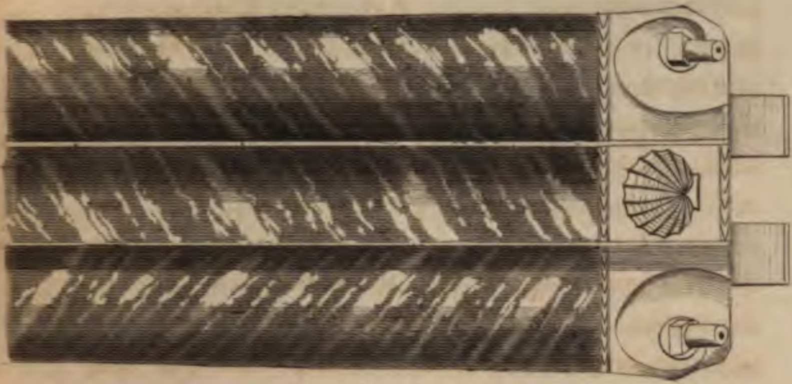
Is almost too bad to make an article, which may endanger the limbs of our fellow-creatures. It is made of an inferior scrap to the former, in precisely the same manner. In point of strength it is still lower. The bar is generally one and 1-16th inches in breadth, by 3-16ths thick, the solid contents two inches and 25-64ths, and will bear a weight of 7,840 lbs., and consequently the strength will be 2,840 lbs. to the inch of tube.

This is a great falling off in strength. I would ask any one who values the safety of his hand, if he would like to risk it, by using a gun, made of iron, possessing so low a degree of strength, as compared to the force of the charge it has to bear? Let him recollect that the force of the

charge may be increased by a variety of circumstances. The pressure of a certain quantity of powder, on which a certain weight of shot is placed, is so many pounds to the inch. If you double that weight of shot, you nearly double the pressure. In estimating the force of pressure, the opposing friction is also to be taken into account. If the gun be allowed to get very foul, that friction is increased, and, of course a still greater pressure is thrown on the tube of the barrel. All these circumstances being taken into consideration, I repeat, that no barrel is safe, whose power of resistance is not more than double the strength of a charge of sufficient force for general shooting. Every such gun should be thrown aside as unsafe, or used with the greatest caution.



The wideness of the twist will easily enable every person to detect a barrel made of this iron. The reader will also pay attention to the cut of the iron in the state for welding, and also to the engraving on the opposite page, of a barrel in



TWO PENNY IRON BARRELS.

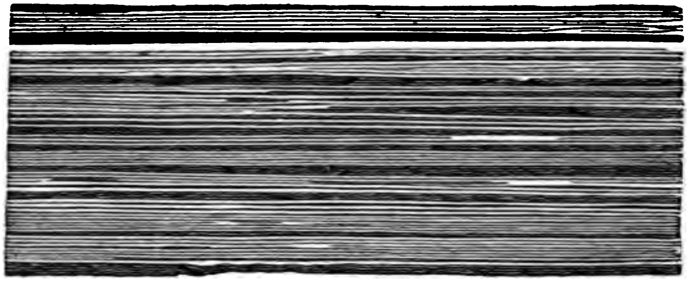
A SHAM DAMN BARREL.

the finished state. These barrels are made into guns that usually sell for about four guineas, double; two guineas or fifty shillings for single, though they may be bought considerably cheaper in Birmingham: they are generally dealt in by the Jew dealers, sale shops, &c., in London and all large towns.

CHAPTER IX.

SHAM DAMN SKELP.

The name of this iron will convey an idea of what it is. Its composition is the most inferior scrap. I should not have mentioned this description of iron had I not seen hundreds of barrels made of it, and did I not consider them perfectly unfitted for the use of any person who cares at all for his safety. I have met with them under the dignified name of twisted barrels, more frequently under that of what their name denotes.



The above is the appearance of the bar when intended to be twisted. Guns that are fit up from twelve shillings to a pound, are not patent breeched, but are made to appear so by staining them generally blue, and by having a couple of

bands to imitate platina, across the squares. A projecting part is welded on to the side, into which the nipple is inserted, and the lock joints neatly under it. Certainly, many of them are good imitations, but once take the barrel out of the stock and the deception is instantly apparent, as it is rarely carried further than the outside.

The beautiful way in which the barrels are painted to imitate fine twist, catches the eye of the simple countryman, who is generally the dupe of this artifice; and the persuasive eloquence of the itinerant hardwareman seldom fails to extract from the pocket of his unsuspecting purchaser sometimes thirty or forty shillings of his hard earnings for what the knavish trickster rarely pays more than fifteen shillings. Many are the anathemas vented when the deception is found out by some one more knowing than the poor dupe, who not unfrequently purchases his experience at the expense of a finger or a hand. It is astonishing what a quantity of this rubbish is disposed of by the wretches who infest market towns and villages with these guns for sale.

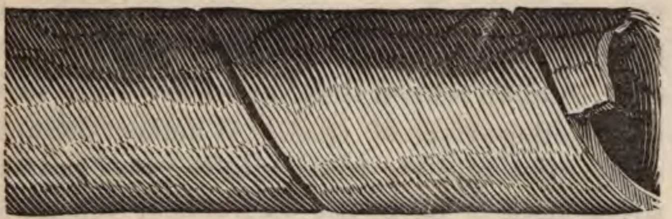
But the English peasant is not the only dupe of this species of knavery. Thousands of these guns are sent monthly to the United States, to the Brazils, and South America, where they are disposed of among the poor Indians in exchange for skins and furs. They are all understood to be proved. How many there are so I

cannot tell; but that some of them are not, I have not the least doubt. It may be said that the manufacture of these guns is a great support to the gun trade of Birmingham. It is, certainly; but would not the interest of the trade be advanced, if we were to manufacture none of so inferior a quality? "But then we could not compete with our rivals in Germany and the Netherlands." True; we should not be their rivals in the production of rubbish, but the superiority of our guns would then command a market. It is by sending to the market an article no better than theirs, that has begun to make foreigners indifferent about the purchase of ours, as they say the English guns are no better than the Dutch or German, we may as well purchase one as the other. The truth of this remark is illustrated by the state of the African trade. The base kind of articles we supplied them with some years ago, has produced a distrust of our manufacture, which will not easily be removed. In the course of a few years, no doubt, a similar distrust will be engendered by the same cause, in the minds of our present customers. It is much to be deplored that the consideration of present gain should render men blind to the consequences of their conduct, and lead them to prefer the immediate gratification of their avarice to the future welfare of themselves and country.

The method I suggested of testing all irons

in the bar, would go far to destroy their trade. I have not thought it worth while to test this iron Twist barrels are made of it. Should the reader meet with a double gun so made, let him avoid it: it is unsafe, unless it be so heavy as to be unmanageable.

The inclination of the twist will be seen by the wood-cut underneath.



A great many long rifle barrels are made of this iron, principally for the American trade; but from their immense weight, and the small charge of powder required, there does not exist the same danger.

Fowling piece barrels made of it may be generally recognised by the smallness of the bore and the thickness of metal. As the charge in proving is very small when compared with charges for proving guns of a wider calibre, we need not be surprised that many of those that are proved stand proof.

CHAPTER X.

SILVER STEEL.

It never rains but it pours, says the proverb. Since I wrote the first part of this work we have been deluged with new inventions of silver steel, doubly refined steel, and I know not how many other sorts of steel. Whether there is any portion of silver fused with the steel termed silver steel, I have not ascertained, though I should think it an improvement.

Barrels made from it look very well, and are particularly clear of greys.

The next description, viz.:—doubly refined steel, looks well; but with each of them they have fallen into the same error—that of twisting in the rods similarly to the Damascus or Mr. Wiswould's mixture, only in more fantastic shapes: in addition to which they have been going to the extreme with hammer-hardening. As this is an operation I recommend, I will, before proceeding further, make a few observations, lest the reader may think me inconsistent.

I recommend hammer-hardening in all mixtures containing iron. If you throw the iron aside, and confine your manufacture wholly to

steel, it would be an evil, from this simple cause:—steel is of itself close enough in the grain; hammering it, therefore, in a cold state, only tends to make it more brittle, but the reverse is the case with iron; the more it is beat the greater becomes its tenacity; and when mixed with steel in the way the stubs composition is, it prevents the particles of steel from becoming too hard. This has been fully proved. A celebrated barrel-maker, in Birmingham, has been making doubly refined hammer-hardened steel barrels, single refined steel barrels, &c. &c., for which, in the rough, he has had the conscience to ask the moderate sum of ten pounds a pair. These, when proved in London, have stood the proof, but when proved in Birmingham, have been blown to atoms. How is this, it will be asked? The reason is simply this:—when proved in London, the barrels are generally put together, and, consequently, the hammer-hardening has been destroyed by heating them red hot to brase the ends, (which, by the by, proves two of my positions, if proof were wanting); when proved in Birmingham, they are generally proved singly, previous to the brasing at the ends, &c., and with the extreme hardness given to them by hammer-hardening still existing, the cause of the failures of these plans, for failures I must call them, is a want of the knowledge of metals. I admit that the harder a barrel is, the better it is calculated to shoot with a cylinder

bore, or without any artificial friction from the smallness of the expansion; yet in endeavouring to obtain hardness, you must not destroy your strength or tenacity, or you increase the danger of bursting. This is what these inventors, as they term themselves, have lost sight of: they imagine if they stand proof they are safe—a fallacious idea—the present proof is no test; therefore I again say, the mixture that will stand the greater tension in the rod, will make the safest, and, consequently, the best barrels for all purposes. But if you quit iron without finding a better substitute, you step over the line of demarcation; as I am fully convinced from experience, that an equal substance of the best steel ever invented or made is less in tenacity than a mixture similar to stubs and steel—for instance, when testing a bar of steel with the testing machine, I have struck it with a small hammer, and it snapped like a piece of glass, while a bar of the same size, &c., made from stubs and steel, would bear a stroke twenty times the weight. This completely proves that if you want safety, you will not find it in steel barrels. My readers must not infer from this that I disapprove of steel, in a greater quantity or quantities than what is at present used in the manufacture of the best gun barrels. In fact, I think that a greater quantity of steel with the stubs would be a decided improvement. I say

go on improving the tenacity of iron in the rod, and you will improve the quality of your barrels;—therefore, in proving any new invention of mixed metals, use a testing machine as an indispensable requisite: without it your endeavours will be futile.

CHAPTER XI.

SWAFF IRON FORGING.

THERE is a profitable branch of iron forging carried on in Birmingham under the above title. It is an iron which is composed of iron and steel filings, chippings of breeches pieces, and cuttings of the ends of the screws, lock plates, cocks, and the rough borings of barrels, and all other small scraps found in gun-makers' work-shops. These are collected by the boys in each shop, and when they have accumulated sufficiently, are sold to the swaff-forger, and the proceeds are considered as drinking money. By him they are forged into bars of iron, attaching them together by immersing them in diluted sulphuric acid, and after draining them from it again, and placing a large iron pan full in a hot situation, they become cemented together by the action of the acid. The compound is then taken from the pan by turning it upside down, put into an air furnace, heated to a welding heat, removed and beat into a bar, by three men with light hammers beating it as quickly as they do in welding a gun barrel. The iron is sold to the gun-work forgers for the forging of

the patent breeches, lock plates, furniture, and other parts of the gun they think worthy of good iron; but since cheapness has become so much the order of the day, the use of this iron is certainly confined to the forging of best gun-work, cast iron, being thought quite good enough for common gun-work.

With these remarks I conclude my observations on the various sorts of iron used in the manufacture of gun barrels, and shall proceed next to describe the mode of welding these various descriptions of iron.

CHAPTER XII.

BARREL WELDING.

THIS is a stage in the manufacturing of guns which requires the utmost skill. The slightest carelessness even on the part of a skilful welder would render work given to him to manufacture into barrels of the best quality unfit for finishing. This is the cause of so many barrels being sold as wasters, the iron being full of flaws and greys. We ought, therefore, to be very particular in the selection of the workmen to whom the working of the barrels of the best quality is trusted, as there are but very few worthy of the name of good workmen, and these are becoming still more scarce in consequence of the continual reduction of the amount of their wages. These reductions render even the best workmen careless; for they will not bestow upon their work the time that good forging requires. We must remember, too, that the quantity of fuel required for welding barrels is very great, consequently, expensive. The forge of a common smith can give my reader no idea of the immense quantity of fuel required in bar-

rel welding. I confess I was myself astonished when I first saw a welder's forge composed of more than two hundredweight of coals and coke. The workmen, too, are obliged to spend several hours in forging barrels of a commoner description before they can be sure that the fire is fit for welding barrels of the best quality. The cause of the London barrel forgers never obtaining perfection in barrel welding was this:— they would not condescend to make barrels of an inferior description, consequently, they had nothing wherewith to bring their fire to a proper state: hence the reason they have been superseded by the barrel-makers in Birmingham. For the truth of this assertion I can confidently appeal to those who have known, or are in any way connected with the trade of the two places for the last ten years.

But with respect to welding. Three men are required. The foreman of the fire, as he is termed, on whose skill all depends, and two subordinates, whose duty it is to blow the bellows, strike, &c. When they have received orders for a sufficiency of the various kinds of barrels to employ them a whole day or more, the fire is kindled. They proceed to weld probably a dozen long common barrels for the American trade, which are generally composed of the inferior iron, mentioned before, rolled into two lengths of different thicknesses. These are heated, and beat on a groove until they form

a tube half closed. They are then heated again, and closed with the one edge over-lapping the other, as a brazier would over-lap the edge of a tin pipe, for boys to blow peas with. Having got the two lengths of the whole dozen turned into tubes, they proceed to weld the longer length or fore part, by heating it sufficiently for four or five inches, introducing a mandril of the required size to suit the bore wanted, and then beating it into a perfect tube, in a groove, on the anvil, of corresponding diameter; heating it again and again, until the joint is closed the whole length. They then proceed with the other eleven fore parts, and advance the whole to that stage before welding on the breech lengths, which are now partially heated by laying on the outskirts of the fire, to be in readiness: they are then closed the same as the fore parts. The end, when about to be jointed, is opened a little on the peam of the anvil, to admit a portion of the end of the fore part, which is introduced as soon as both are in a welding state; the mandril is then introduced, and the joint is perfected in less time than I have occupied in the description of the process. The other part of the tube is closed, and the barrel is complete. If, however, the breech part is to be square or octagonal shaped, it is not welded in a groove, but on a plain surface. When the dozen are finished, the wages of the workmen rarely exceed one shilling for each barrel, and fre-

quently not more than nine-pence. This remuneration seems very inadequate, when we consider the labour and expenses incurred; as no labour is more severe than barrel welding, and no workmen are exposed to a greater violence of heat, especially in summer, so no class of mechanics require better food and drink for their support than gun-barrel welders. Finding that their fire is now in a proper state, they prepare to commence the welding of the best iron. It is twisted by means of two iron bars,—the one fixed, the other loose. In the latter there is a notch to receive one end of the rod. When inserted, this bar is turned by a handle. The fixed bar preventing the rod from moving, it is twisted round the other like the lapping of the joint of a fishing rod, or the handle of a whip. The loose bar is then removed, the spiral knocked off, and the same process recommenced on another rod. The length of the spirals depends entirely on the breadth of the rod—for instance, the stub-twist having sixteen circles in six inches, a rod of five feet will only make a spiral of seven inches long, while iron of an inch in breadth will make a spiral of as many inches long as there are twists. This is the reason that the best barrels have more joints than common ones in the same length.

Having twisted as many as they want, those that are intended for the breech end, are

heated to a welding heat for about three inches, removed from the fire, and jumped close by striking the end against the anvil. Again they are heated, and again jumped, to ensure the perfect welding. They are then beat lightly in a groove, to make them round. The neatest part of the process consists in the joining of the points of the two rods so as to make the barrel appear as if it had been twisted out of one rod. The ends of the two rods are a little detached, brought from the fire, and applied to each other. A gentle tap is then given, and the union is perfect in an instant. The rapid dexterity with which this is accomplished, ought to be seen to be duly appreciated. This trouble is only taken with the best barrels. In the manufacture of barrels of an inferior description, the ends of the rods are cut in a sloping direction, which, when welded together, become quite square at the part where the pieces are joined. In a finished barrel the points of junction are easily recognised. By tracing the twist, a confusion will be found to exist for about an eighth of an inch every six or seven inches. From this appearance you may conclude that, for a barrel so joined, the welder had not the best price. Having joined the whole of the spiral, three inches are again heated to a welding heat, the mandril is introduced, and the tube hammered, in a groove, to the size required. This operation is repeated until the whole length is

finished. This being done, then follows hammer hardening, that is, beating the barrel in a groove in the cold state, with light hammers, for the space of half an hour. This is a most important part of the process. It closes the pores, condenses the texture of the metal, compresses a greater substance into less bounds, increases greatly the strength of the barrel, and renders it more elastic. This, however, is seldom done, unless specially requested.

A gratuity is, of course, expected, either of money or beer, and I believe a few pots of the blood of Sir John Barleycorn will infuse more strength into your barrels than you could purchase for ten times the amount in money, as it has the effect of making the hammer descend with increased velocity. Many of our learned Thebans have been racking their invention and puzzling their brains to find out the composition of which Damascus sword blades are made. We have been told of the great discoveries they have made of mixtures of platina, and silver, and copper, &c. They have vaunted of their boasted discoveries, and boldly asserted that the excellence of these blades depended on a peculiar mixture in the steel. As if to mock the profundity of their researches, it turns out that this composition consists of nothing more than the mechanical mixture of irons and steels, containing less and more carbon, which men are employed to temper, by continually beating for weeks,

and in some instances for months together. This long continued hammering gives a temper which no other means can bestow. The barrels, also, are hammered, but not to the extent the swords are. I have seen twenty-five guineas given for a Damascus barrel, yet I know of no reason why we cannot produce a barrel as good, if not superior. If all barrels were hardened in this manner, their shooting powers would be increased, and they would not be so liable to burst in the hands of the sportsman. This, however, cannot be done, unless the purchaser sees it done himself, or has it done under the superintendence of some person on whom he can depend. The Birmingham workmen, if well paid, and well looked after, (to counteract the bad habits they have acquired from being employed in the manufacture of so large a quantity of goods of an inferior quality) would produce an article superior to any that could be produced at the same cost in any other part of the world. I say this in the very teeth of the sneers of the London gun-makers. Were there but a few more makers in Birmingham that understood the nature of guns, their use, and how to take advantage of the many facilities they have even at the door of their own work-shops, which the London maker neither has, nor in all probability ever will have, competition would soon cease, if not to the satisfaction of the metropolitan manufacturer, at least to that of the sporting world.

Having got your barrels hammer hardened to your satisfaction, look sharp about you, lest the advantages your barrels have derived from that operation be not destroyed by a process which, though held as one of the greatest improvements effected in gun making for the last ten years, I do not hesitate to decry as a most pernicious practice, I mean brazing the breach-ends of double barrels. I shall content myself here with this hint. In the proper place I shall fully demonstrate the injurious effects of this practice.

Such, then, is the process of barrel welding. I have only to add on this subject, that all twist barrels are welded in a similar manner; but the time bestowed on the process is invariably determined by the price; the forging of twist barrels varying from two shillings up to fourteen shillings per pair, and single barrels from one shilling to seven shillings each. Barrels exceeding the usual size, or falling short of it, are charged as a barrel and a half, two barrels, &c. according to the degree in which they vary from the standard. In fact the charge varies with the size in all the stages of the manufacture.

The deceptions practised in this branch are numerous, and injurious to the trade. For instance, if you wish to have a heavy single barrel made from Damascus, or any of the best irons, and you send to the manufacturer the weight of iron required, the probability is, that unless you superintend the manufacture yourself, iron of an

inferior quality will be introduced into the inside of the spirals. By this fraud they obtain iron worth three-pence a pound more than that which they knavishly insert into the barrel. I had been repeatedly told of this practice, but I was incredulous. However, I gave an order for four very heavy rifle barrels to be made of Damascus iron. They were made. The charge was enormously high. This was a matter of secondary consideration; but on pickling these barrels for the purpose of shewing the figure of the Damascus, I discovered at the muzzle that the iron seemed to be much more easily eaten away than on the surface. This lead me to examine them, when I found that the inside was entirely composed of common iron, over which the covering of Damascus had been twisted. But for the pickling, this fraud would never have been detected; yet for these barrels I was charged at the rate of two for each. Since this occurred, I have subjected many heavy barrels to examination, and I find the fraud to be very common. The practice is not only dishonest, but spoils the gun. It destroys the shooting power in consequence of the metals being of different temperatures, not acting together at the moment of expansion. Pistol barrels that are made very heavy are, in general, forged this way, as well as all heavy duck guns, that are ordered to be manufactured of the best iron, especially at the breech ends. It may be asked, how do

they dispose of the iron? What market have they for it? Faith, they are like the tailors—they are fond of cabbage. From their accumulated thefts they forge barrels on their own account, which they dispose of to those gentry who live by making up waster guns. Sometimes, indeed, those country blacksmiths, i. e. gun makers who go to Brummagem, as they term it, for once in their lives, to buy their materials, and who, thinking themselves a match for these accomplished knaves, become their dupes, as they are invariably taken in. Many of these barrels are certainly perfectly sound; but then, they are like a coat made from cabbage, variegated with cloths of different textures and colours, being made from irons of every description of twist; sometimes three or four different sorts of iron in one barrel. In short, cabbage of all kinds is forged and welded together in the composition of a single barrel. A sportsman may, therefore, easily detect a gun of this quality if offered to him. This is not the only instance in which welders are parties to imposition on the public. By a regulation established among the more respectable barrel filers, if a barrel should be found very faulty, by any neglect of the forger, the faulty barrel is returned, and the forgers receive nothing for their work. If by any means they can patch it up, it matters not how, buyers are easily found in the convenient gentry before mentioned. If, however, the filer be not a con-

scientious individual, he sends back the barrel merely to show the forger his fault, with an offer to deduct so much from the price. This offer, being generally a little more than could be obtained from the market in reserve, is, after a little chaffing, accepted, and the barrel filer contrives to hide the defects from the ignorant and unsuspecting eye of a country customer; or, as they are generally termed by these gentry, "A yokel come to take them in—*poor souls!*" It is to be understood, that most filers find their own iron, and send it with the iron to the forger; if he returns the barrel which he declares faulty, he, of course, loses the iron; if, however, he can drive an advantageous bargain with the forger, he saves the cost of his iron, and makes a capital profit by the deduction from the price of the forger's labour. At all times there is a keen contention between them. It is diamond cut diamond.*

The ribs and pipes are generally forged in their own shops by the filer, from iron prepared on purpose. All pistol barrels are forged two together, and even more, according to their length and size. Muskets, and other common barrels, are now welded in one heat by a machine invented by the late Mr. Clive, the iron founder,

* These objections and remarks do not apply to those respectable gun makers whose barrels are made under their own superintendance, and, in some instances, on their premises.

which I shall describe in describing the manufacture of muskets. This invention has so irritated the welders, that there is, at the present time, a combination against his successors; therefore, Mr. Adams has been a gainer by their refusing to work Mr. Clive's iron.

We shall now step into the boring mill, and see what objections can be stated to the present method of boring.

CHAPTER XIII.

ON BORING, GRINDING, AND TURNING GUN BARRELS.

In all large towns there are manufacturers who possess what is called spare power, viz., having a steam engine of greater force than is requisite for their own purpose. The proprietors erect and let workshops to various artificers who require the aid of steam in their business. There are even capitalists who erect steam engines, and build work shops, which they let at moderate rents to eight or ten different tradesmen, of various mechanical business, and amongst these you will generally find both borers and grinders.

The borer occupies a very small shop—the grinder a large one. Two men and two boys are generally found in a shop. There are four benches, to each a spindle, in which there is an oblong hole to receive the end of the boring bit. The barrel is secured on a sort of carriage, which is at liberty to traverse the whole length of the bench. A boring bit is then selected of suitable size; it is put into the spindle, and the point introduced into the end of the barrel. A sort of lever is then taken and hooked on to a sort of staple, or piece of hooked iron (a number of

which are fixed in one side of the bench the whole length), passed behind the carriage to force it up to the bit, which is removed and fixed again, until, by forcing up the carriage, the boring bit has passed through the whole of the barrel. During this operation, a stream of water is kept playing on the barrel to keep it cool. A bit of larger dimensions is then introduced and passed through, and others of still larger dimensions, until the whole of the scales or blacks are entirely bored out, or until the barrel has become so large in the bore as to preclude any further boring with safety. If the scales are of great extent, the fault is the forger's, and the loss will consequently be his. If the barrels be found perfect, they are sent back to the filer, or he comes to inspect them in order to ascertain whether they be perfectly straight in the inside; if not, to make them so. Some borers profess to be able to set their barrels themselves; for doing so they make a charge. The setting of barrels is a point of great importance. Many profess to set who cannot do so at all. I have frequently been amused to see men that are paid very liberal wages entirely for inspecting barrels in the different stages of manufacture, take a hammer of an ounce weight and give a barrel two or three taps that would not kill a fly, then pass them as being quite correct. Really it is too bad to see men gulled in this manner. Certainly, they may sometimes be able to discover an error that a

blockhead of a filer had overlooked; but it is not in the power of human vision to tell to a certainty when a barrel is a shade out of truth—that is, bored spherically. Were it polished lengthways or horizontally, it might be practicable by the shades of light; but the reflection and refraction are too great to enable any one to judge correctly. For the purpose of ascertaining that a barrel is set correctly, I would recommend that bits of the length of two feet six inches (in the squares or cutting part), or longer, should be ground mathematically correct, and perfectly cylindrical. With these a piece of copper, (technically termed a spale) having one side partly round, the other flat, should be used, laying this on one square of the bit to prevent more than two edges cutting at one time. This would have the effect of making the barrel perfectly round, and perfectly true. A bit of this description should always be passed through as a corrector, and would obviously be more correct than any person's eye. It may be asked, "Why all this nicety in the first stage?" Such nicety is of more consequence than many persons imagine. For instance, were the bore not straight when the barrel came to be turned on the outside, one side would be quite thin, while the other would be thick. And no one, I should think, would regard a barrel in such a state, as one of the best description, or fit to shoot with. Barrels intended for some of the London makers are sent off in this state; they are then turned

in a self-acting lathe, which, when once adjusted, turns the barrel perfectly conical from the muzzle to the breech, without any alterations. I suspect, however, that these lathes are made useful for puffing purposes, as well as barrel turning. They are capital things to talk of: they enable those that possess them to talk of the superior means they have over other makers. At all events, I know what many of these manufacturers of great pretensions would not like to be known by their customers. I know, and the London proof could bear witness to the truth of what I assert, that they obtain many of their barrels from Birmingham, ready put together. I do not deny, that by their lathe they may be able to finish in as good a style; but they may, and do obtain their barrels finished quite as well, and much cheaper, from Birmingham.

Those intended for home consumption, as I may term it, are now sent to the grinding mill, as it is not customary for either to have the barrels fine bored until they are proved. As, however, it will be inconvenient to recur to this subject, I will mention here how the barrels are fine bored. Having stood proof, and being now ready for finishing, they are sent to the finishing borer. Some barrel makers have boring benches of their own, worked by hand; others employ borers. A superior tool is required for this part; along with it a copper spale is used. Some use wood. The barrels being fixed on the carriage,

a chain is attached, which runs over a pully. To the end of it a weight is suspended, which, acting on the carriage, presses it up to the bit, and passes through the whole length of the tube. The copper is then removed, a slip of paper is laid between it and the bit, and the barrel is again bored twice or thrice until it gives satisfaction. They are assisted in obtaining the requisite fineness generally by oil—though some profess to think soap and water best. To a man of ability either would answer the purpose. A bad workman blames everything but himself. It must not be understood that the fine borer warrants to make the barrels shoot. His only wish is to obtain a fine inside. He cares not whether it be a cylinder, or whether it have relief behind or before: it is all the same to him. It is true, the majority of barrels, as they come from Birmingham, are nearly cylinder bored; yet, not one out of twenty—nay, one out of a hundred guns made, are tried; none, except those made by a few celebrated makers: with the rest it is all chance. You may get a non-such; you may get an abominably bad one. Very few, even of the first-rate borers, ever shot a bird larger than a sparrow in their lives; and of these, the farmers in the neighbourhood thank God that they do not leave many to destroy their seed.

When the barrels have been found all right, they are sent to the grinder, by whom they are

ground to the size required on large stones, which revolve at a terrific rate. The skill acquired by many of these workmen is astonishing. Over and over again, have I seen barrels coming from the mill put into the lathe, and found almost as true as if they had been turned. They have a method of allowing the barrel to revolve in their hands at half the rate of the stone, and by this method they grind them so fine, that many would be puzzled to determine whether they had been turned or ground, were the barrel smoothed lengthways, merely to take out the marks of the stone. I have seen the squares of a rifle barrel ground as perfect an octagon as the eye could assist in forming. Best barrels are generally turned after they are ground. Inferior barrels are struck up with a large rubber, or smooth, by boys ; in some instances by women. They are then tapped in a temporary way, the proof plug is screwed in, and, with that trifling smoothing, are sent to the proof-house.

The London proof house, to which a great many barrels are sent from Birmingham, requires the barrels to be breeched, and double barrels soldered together, to prevent any reducing after proof. The Brummagems, however, contrive to evade this regulation, which is an excellent one, were it invariably acted upon ; which is seldom the case. Care must be taken that the borer does not, from finding a difficulty in boring, take

and soften the barrel, and thus destroy that condensed strength and hardness which you have been at so much pains to obtain by hammer hardening. Hundreds of times they have been detected in these tricks; how many hundreds they have escaped, I do not know. It would be well, after having got your barrels rough bored, to take them (whether you mean to have them turned in a self-acting lathe or not) to the grinder, and have merely the scales ground off; then take them again to the forge, and pay the welders to bestow a few more minutes upon them with their hammers. This fresh hammering will shew any defect which may have escaped your attention: at all events it will assure you that they are sound, and give additional strength to that already acquired by the previous hammering. After this, if the fitting up goes on as you have begun, you will be able to flatter yourself that you have got a good gun.

Were I to follow the usual routine I should describe the proof next; I shall, however, confine myself to the understanding that we are preparing to prove our barrels after the London regulation, which I have mentioned above. After the barrels have been bored, it remains to be determined whether they shall be ground or turned in a self-acting lathe or a common one. To obtain truth it is important that they should be turned. As to grinding, I should not have

mentioned it, did not a practice exist of partially grinding them; namely, taking off a portion of the superfluous metal by the stone, and afterwards turning them, as it relieves the lathe, and removes the scales, which are injurious to the edges of the tool. The way of fixing them in the lathe is by having a number of plugs or mandrils, which are perfectly true, and of various sizes, to fit different bores; these are centered and put on the centres of the lathes; a carrier is then secured on a part of the plug that projects out of the breech end of the barrel; it is then put into the face-plate of the lathe, which carries it round. The leading screw that travels the slide rest is then set in the angle the barrel is to be turned to (though some lathes have not the power of alteration, but turn all barrels in one angle); the slide is next adjusted to the thickness of the muzzle wanted; and, when all is ready, the lathe is set a going, and the leading screw is turned at the same moment by the machinery connected, which keeps the tool cutting sufficiently keen to turn a barrel in about twenty-five minutes. This being done, nothing more is required than a fine smooth file to remove the marks of the tool. Of this mode of turning barrels there can be no doubt of the superiority, if due care only be taken with the tool. If it gets blunted by any scales or impurities, it is apt to tear pieces out of the barrel similar to the rings that may be noticed in a

slovenly bored barrel, owing to dirt getting on the edges of the bit. In turning a barrel by a common lathe, it is fixed in the same manner as before; about an inch of the surface at the breech and the muzzle is turned to the diameter wanted. The rest is then removed, and half an inch more is turned four or five inches from either end; then another half inch, at another distance of four or five inches, and so on, according to the length, making an allowance each time in the depth of the turning according to the taper of the barrel. The iron between these cuttings is then filed off by floats the lengthways of the barrel: this is a sure mode of getting the barrels perfectly straight on the outside, and without any of those hollows and shades which may be always discovered in an ill-made barrel. It is astonishing how beautifully many barrels are struck by the float. The mode of turning by the lathe is, however, cheaper.

As soon as the barrels are ready for being put together, they are filed away at the breech and muzzle flat, for a few inches, until the middle parts of the barrels shall bear against each other. All barrels, especially those of Birmingham make, are a little hollow in the middle, so as to make the fore end as light as possible, in order that it may balance better. The London makers say there should be no hollow at all; that the barrels should be perfectly conical. In my opinion they are right, provided the breech ends

be not too strong or thick in the metal. In this case, if the middle of the barrel is exactly half the difference in diameter between the diameters of the breech-end and the muzzle, the barrel would be very heavy indeed; whereas, if you make the middle of less diameter, it gives the barrel that hollow appearance, and makes it much lighter. The London barrels, being conical, are generally flattened, less or more, the whole length. This is done to cause them to throw their shot correctly. Attention to this point is one of the best tests of a skilful gunmaker; for barrels of different lengths and thicknesses, require to be differently jointed, so that they shall not throw their shot across each other too much, but to certain points at a given distance.

As soon as the barrels are properly jointed, care must be taken to see that they are perfectly level. If the barrels be not level, it will be impossible to shoot correctly, as one barrel will throw the shot above, the other below the mark. This being done, the barrels are bound together and brazed with hard solder or brass, for about four or five inches. Greater injury cannot be done to barrels than is done by this pernicious practice, for they cannot be brazed without being heated to a white heat; by this heat, all the advantages derived from hammering are dissipated at once—the condensation is gone, and the strength is reduced at least 12½ per cent.; and for what purpose? Under the

pretence that the barrels are firmer and not so liable to become loose. This is a point trivial in importance compared to the excellence and strength of the barrel; for even if they have received no more hammering than is necessary in the forging, they are still injured to the extent of 12½ per cent; for even beating them when hot, improves them much, provided they be not heated again; but if they have been cold hammered, the injury is full 30 per cent. Yet even for this injurious soldering, an extra price is charged. A circumstance which shows how little the principles of gunmaking are understood by the first gunmakers; for the brazing of barrels is practised by all.

The barrels are next tapped for breeching. There are methods of cutting the screws in lathes, but it is far inferior to tapping; as a thread cut has never the strength of one forced up by a tap; nor is the test to the barrel any thing, when, by tapping, it amounts to a severe proof. In fact, many barrels split in the operation. The female breech, after being tapped, is screwed into the barrel to its place, and a tool, called a grinder, is introduced into the tube of the other barrel, and by being turned either, by the lathe or by a brace, it cuts away that part of the female breech required to allow the male breech, when turned to a corresponding size, to fix in neatly. They are then filed down to the size of the barrels partially bored in the inside,

and a communication hole drilled through the under part. This being done, they are ready for the London proof. Some, indeed, solder on the ribs; yet the general way is to send them in this state, lest they should burst, as the loss would then be greater.

CHAPTER XIV.

ON THE PROOF OF GUN BARRELS.

THE necessity of the establishment of a house for proving the strength of gun barrels, was made apparent to gunmakers and others interested in the trade, by the immense quantity of guns that were manufactured at Birmingham, and elsewhere, without being submitted to any proof whatever. They were manufactured without any regard to strength, and were sold with the knowledge that even a moderate charge would burst them. This miserable description of article was known in the trade by the denomination of park-paling, sham-guns, &c. No sooner was public attention called to the subject, than some public-spirited and conscientious individual called a meeting. The establishment of a company was the result, which was incorporated by Act of Parliament, in the year 1813. Previous to that period, a proof-house established by the Company of Gunmakers in London, about the end of the eleventh century, existed, for the proof of the better sort of fowling-pieces.

At this establishment, the muskets of the East India Company were proved. There existed before this time no enactment to compel

the proof of guns. Some of the leading gun-makers in Birmingham had, indeed, small proof houses attached to their manufactories where they tried their guns with a charge of what strength they deemed sufficient; yet thousands upon thousands of barrels were sent forth without having been submitted to any proof whatever. These guns were manufactured for the dealers in slaves, by whom they were carried to Africa; and there a gun untested, and without strength, was given in exchange for a man! Numbers of mutilated wretches were to be seen in that country; and we have the testimony of travellers, that multitudes have lost their lives by the explosion of these worthless guns, the victims of the avarice of men denominating themselves Christians. I am sorry to say, that many guns are yet made very little superior in quality to those park-palings, and will continue to be made, unless put down by the strong hand of the law.

The Act obtained by the Company made it penal to manufacture and sell any gun without first having it proved, either at the proof-house in London, or at the house established for this purpose at Birmingham. It also ordained, that all barrels should undergo the test, with the charges specified in the annexed scale.

PROOF SCALE.*

No. of Balls to the Pound avoir.	Weight of Powder for Proof.	No. of Balls to the Pound.	Weight of Powder for Proof.	No. of Balls to the Pound.	Weight of Powder for Proof.	No. of Balls to the Pound.	Weight of Powder for Proof.	No. of Balls to the Pound.	Weight of Powder for Proof.
	oz. drs.		oz. drs.		oz. drs.		oz. drs.		oz. drs.
No. 1	11 0	No. 11	1 0	No. 21	0 10	No. 31	0 7½	No. 41	0 6
2	5 5	12	1 0	22	0 9	32	0 7½	42	0 6
3	3 8	13	0 15	23	0 9	33	0 7	43	0 6
4	2 11	14	0 14	24	0 8½	34	0 7	44	0 6
5	2 2	15	0 14	25	0 8½	35	0 7	45	0 5½
6	1 12	16	0 13½	26	0 8½	36	0 7	46	0 5½
7	1 8	17	0 13½	27	0 8½	37	0 7	47	0 5½
8	1 6	18	0 12½	28	0 8½	38	0 6½	48	0 5½
9	1 2	19	0 11	29	0 7½	39	0 6½	49	0 5½
10	1 1	20	0 10	30	0 7½	40	0 6½	50	0 5½

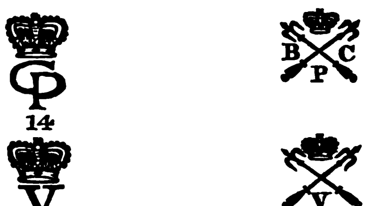
* In addition to the above scale, I will add one which will convey, at one view, the diameter of the ball weight of powder and lead.

DIAMETER OF THE BORE AND WEIGHT* OF POWDER AND BALL IN OUNCES.

N. of Balls to the Pound avoirdupois.	Calibre of the Bore in Inches.	Weight of Powder for proof in ounces avoirdupois.	Weight of Ball for proof in ounces avoirpos.
No. 1	1,69	11,	16,
2	1,341	5,312	8,
3	1,172	3,5	5,33
4	1,064	2,687	4,
5	,988	2,125	3,2
6	,930	1,75	2,66
7	,883	1,5	2,285
8	,845	1,375	2,
9	,812	1,125	1,77
10	,784	1,062	1,6
11	,760	1,	1,45
12	,738	1,	1,33
13	,719	,937	1,23
14	,701	,875	1,142
15	,685	,875	1,066
16	,671	,818	1,
17	,657	,818	,941
18	,645	,756	,88
19	,633	,687	,842
20	,623	,625	,8
21	,612	,625	,761
22	,603	,562	,72
23	,594	,562	,695
24	,586	,531	,66
25	,578	,531	,64
26	,570	,531	,615
27	,563	,531	,592
28	,556	,531	,571
29	,550	,468	,551
30	,544	,468	,53
31	,537	,468	,516
32	,532	,468	,5
33	,527	,437	,48
34	,521	,437	47
35	,517	,437	,457
36	,512	,437	,44
37	,507	,437	,432
38	,503	,406	,421
39	,498	,406	,41
40	,494	,406	,4
41	,490	,375	,39
42	,486	,375	,38
43	,483	,375	,372
44	,479	,375	,36
45	,475	,343	,35
46	,471	,343	,347
47	,468	,343	,34
48	,465	,343	,33
49	,462	,343	,326
50	,559	,343	,32

* This Scale is taken from a small work published by the authoiity of the proof company.

This act, however, was not found sufficient to effect the purposes contemplated by the legislature: it was therefore amended in the year 1815, and the amended Act has been in force ever since. By this it is enacted, that no barrel shall be received by any person to rib, stock, or finish, that has not been duly proved, under a penalty of £20. It is also enacted, that all barrels shall be sent immediately from the maker to the proof-house for proof, before the same shall be sold, or transmitted for sale, or under pretence of sale, to any person whatever. A penalty of £20 is attached to the breach of this enactment, and it further visits, with the like penalty, any one receiving such barrel to make up. There is also a penalty of £20 for forging or imitating the proof marks of the two Companies; impressions of which will be found below.



LONDON MARKS. BIRMINGHAM MARKS.

On the quantity of powder given in the above scale, is put a ball of lead of the size of the bore.

It is customary to put between the powder and ball a roll of paper, and on the ball a second roll. These have the property, owing to their con-

struction, of expanding when struck by the copper rod, that is used for the purpose of loading, and by fitting the bore completely, are calculated to be of great advantage by increasing the friction, were not that advantage at the same moment partially destroyed by the way in which the paper is struck, tending to compress the powder, and necessarily rendering it less liable to ignite. All powder compressed, resembles the composition in a sky rocket, where, by excluding the air, the length of time required for the explosion of the contents is increased; the truth of this fact may be easily ascertained by tight ramming any gun, and then firing it over a sheet of paper, when a number of grains of powder will be found unburnt. Load the gun again with an equal charge; be careful not to ram it tight, and the whole will be found to have exploded. This proves that hard ramming prevents the full explosion of the charge.

As soon as a number of gun barrels are loaded according to the foregoing scale, they are taken to a house or detached building, standing apart from the other offices. It is lined throughout with thick sheet iron. The windows, which resemble Venetian blinds, are constructed of the same metal. Iron frames are laid the whole length of the room; on these the barrels of various qualities, when about to be fired, are placed. In the front of these frames lies a large mass of sand, to receive the balls. Behind the

frame, on which the twist barrels are fixed, lies another bed of sand, in which, on the recoil, the barrels are buried. Behind the frame, on which the common barrels or muskets are tried, a strong iron bar is placed, having a number of holes large enough to receive the tang of the breech, but not the barrel. The barrels being thus fixed, it is impossible for them to fly back. A groove runs along the whole length of each frame, in which the train of powder is strewed to ignite the charges, upon which the barrels, with the touch holes downwards, are laid. When every thing is ready for the proof, the windows are let close down, the door is shut and secured; an iron rod is then heated red hot, and introduced through a hole in the wall. On touching the train, a tremendous explosion takes place. The windows are then drawn up, the door opened, the smoke dissipated, and the twist barrels are found buried in the sand, the common ones are thrown forward—some are found perfect, others burst to pieces. It is rare that best barrels are found burst—more frequently bulged or swelled out in places which are faulty, or of a softer temper. Those that are found perfect, are then marked with punches of different sizes (but having the same impression), according to the quality of the barrel. In London, they have an additional punch, containing the number of the bore the barrel has been tried by. This mark easily enables the observer to discover whether the barrel has had any con-

siderable quantity bored out after proving, which the marks of the Birmingham proof-house do not; the omission of which, except to a person well versed with the different sized punches, is a disadvantage. Those that are bulged are sent back to the maker, who beats down the swellings, sends back the barrels, and they are proved again They generally stand the second proof, though I have known a barrel undergo four proofs before it was marked. The common barrels are required to stand twenty-four hours before they are examined, when, if not burst, any holes or other material imperfections are made quite apparent by the action of the saltpetre. Such barrels are, of course, sent back unmarked. Those that are found satisfactory are duly stamped and taken home.

I proceed now to state the objections which I have to this mode of proving barrels.

First, I object to the practice of allowing best barrels to rebound into a body of sand. This is a practice calculated to destroy the efficiency of the test to the extent of at least 50 per cent. Gunpowder explodes with equal force in all directions. It necessarily follows that on firing a loaded barrel, the force of the explosion is equally exerted on the breech, the charge of lead, and the sides of the tube.

If we suppose the tube to oppose a firm resistance to any escape of an explosive force in that direction, the force is driven by its

elasticity to find vent in any direction that is easiest. Of course, then, the force is exerted on the charge and on the breech, and the barrel is thrown back as far, in proportion to its weight and the resistance that it meets with, as the ball is projected forward. If, however, the barrel were fixed, as common barrels are, the explosive force, meeting with as firm a resistance from the breech as from the sides of the tube, would be entirely expended in the projection of the charge, and on the sides of the tube. Take, for instance, Dr. Hutton's supposition, that a force of nearly 40,000 lbs. is generated by the explosion of between ,three and four drachms of best powder, which is a large charge in a $\frac{5}{8}$ bore. On this is only the ball and paper, weighing barely one ounce and a quarter. Suppose that it requires a force of nearly 1400 pounds to the inch to move that charge for the first inch, it follows that there is the same pressure on all the parts of equal surface. The breech being fixed, the force is driven back on the barrel and the charge of lead!—it follows, as a necessary consequence, that the pressure on the charge and the sides must be greatly increased. For instance, we will compare it to a man's strength. If he place himself against a wall, as a support, he can move a greater weight with less exertion, and more effectually from him, than if he were to stand unsupported, or against a support that gave way as he leaned against it.

It is the same with a gun barrel. If the explosive force of the powder can escape in two ways, it will not drive both substances near the distance it would drive one, were the force properly concentrated on that one.

I will explain how I first became satisfied with the truth of this fact. I took an old English barrel very small in the bore. Into this I fitted two plugs each, one and a half inch long. My first purpose was to ascertain which description of patent breech was calculated to destroy the recoil most effectually, and then, of course, which would increase the strength of shooting most. Half way up the barrel, I put directly across the bore two wire pins, so that I might be sure each breech was in its place. It will be understood that they were not screwed in. They were merely made to fit the bore as a ball might be, and cupped out in the same manner as patent breeches are, only that the chambers were of different patterns. To ensure the same degree of force acting on each, the touch hole was drilled as near the centre of the two as possible. Having put in the breeches and the powder, on the application of a hot iron the explosion took place, and I found one breech blown 18 yards, the other 32 yards. I then reversed them, lest there might have been any inequality, and I found the result as before; the one being projected to the distance of 33 yards, the other $17\frac{1}{2}$. I repeated the experiment until I was perfectly

satisfied of the superiority of one over the other. I next secured one of the plugs by drilling two holes; one through both the barrel and breech, and one directly behind it, through which I put two very strong iron pins, and otherwise secured it, to prevent a possibility of the explosion moving it. I then put in the same quantity of powder and the breech that had before been thrown furthest, and having secured the barrel against a stone, I fired it as before. The breech was projected to the distance of 73 yards; thus proving the advantage of firmly fixing the barrel, the projectile being thrown 23 yards further than the two together were before.

If any one doubt the truth of this assertion, let him take his gun and load it as usual; suspend it by two ropes so as it can fly back, place a quire of brown paper as directly in front of it as possible; fire it, by squeezing the trigger and the back side of the guard together, so as not to displace the gun; examine the impression the shot has made in the paper. If they have stuck in at the distance of 40 yards, they have done well. Load again, and fire from the shoulder, and you will find the shots driven through a great number of the sheets. Load again, but first take the barrels from the stock, lest you should happen to break your stock; as I have seen done by a gentleman placing his gun on a stone wall; while he rested, the gun by accident went off and shivered the stock into

many pieces, and severely cut his hand by the splintering. (So severe is the recoil from a gun on being fired, when resisted by a solid, unyielding substance. When fired from the shoulder it is different, as the body yields to the recoil, and thus prevents that which would inevitably be inflicted, if the shoulder were placed against a solid substance.) Secure the barrels on a piece of wood, and behind place any thing firm; for instance, a piece of lead sufficiently heavy, and that will not injure the end of the breeches (technically called the huts,) when they strike it. Having secured them perfectly, fire the barrel in any way you can, and then examine the force of the shots in the paper, and if you do not find that they have penetrated further than they did when fired from the shoulder, say my doctrine is false! It follows, as a matter of course, from these experiments, that in shooting, the more firm a gun is held to the shoulder, the better it will shoot.

It is upon these experiments, that I found my objections to the practice of allowing best barrels when proved, to fly back into sand. Such a mode of proof is of no use. Were they fixed like common barrels, the force of the proof would be increased one-half. I doubt whether the present method be any test at all. I am satisfied that the force exerted in this mode of proof on the barrel, is not equal to the pressure of a large sporting charge, when fired from the shoulder.

As all barrels will only burn a certain quantity of powder, they will of course, only generate a certain quantity of explosive force. The quantity generated, I admit, may be increased by adding weight upon the powder, or by increasing the friction. Artificial friction causes the burning of more powder by keeping it longer in the tube; yet it will not increase the test, as the greatest pressure is at the moment the charge is lifted, and the weight to lift is the regulating power—decreasing every inch after that, according to the initial velocity it has acquired. Dr. Hutton calculates the explosive speed of gunpowder at 7000 feet in a second, without any weight upon it. We will suppose that a barrel is loaded with two drachms of powder and one ounce of lead; the proportionate speed is for the first three inches, 1000 feet per second; for the next three inches, 1500 feet; and so on, increasing in speed only so long as there is powder to generate strength.

If, on two drachms of powder, two ounces of shot be placed, the speed will probably be reduced down to 600 feet per second, for the first three inches, and so on; but the pressure on those inches will be materially increased, and the test be more severe by being longer exercised. If we compare the charges used in proving to sporting charges, it will follow, that if the weight of the ball be one ounce, the paper a quarter of an ounce, making one ounce and a quarter all

together; the proof charge of powder is 13½ drachms. Now, I assert, that not above one half of this charge will burn in a barrel 2 feet 8 inches long and 16 bore, with only this weight upon it. Thus 7½ drachms of unburnt powder are to be added to the ounce and a quarter, making in all 1 ounce 11½ drachms in weight to lift at the first starting. With that weight, it will, of course, travel the first inch quicker than the charge of two drachms and two ounces, say 700 feet a second. Now the gun is at the shoulder, with one charge;—the weight of the gun and the support of the shoulder are there to destroy the recoil. The other lays on the frame, with nothing to retard its flying back but its own weight, and that only about two pounds and a half. The case, then, stands thus,—were the barrel fixed, the speed of the explosion would be 700 feet in a second; not being fixed, the speed of the barrel flys back, or obtains an initial velocity in proportion as 2½ pounds are to 1 ounce 11½ drachms; so that as the velocity of the ball is only one-half in proportion to their different weights, it must follow, that the speed of both together is considerably less than would be the speed of either, were the opposite a fixture. It is on the immoveable fixedness of the barrel, that the distance to which the charge is thrown depends, and also the sufficiency of the proof as a test of strength. I am therefore convinced, that the sporting charge is the most severe; for, if the

weight to be lifted is the cause of the greater force being generated, there cannot be a doubt of it.

Without adding the weight of the wadding, there is 4½ drachms more of lead, and that lead being composed of more than one hundred particles is, of course, more difficult to lift, from their tendency to jam up the tube, which a single ball cannot do. Another reason it is more severe, is simply this; if a double barrel, there is the additional weight of the other barrel to be added to the opposing matter, beside the weight of locks, stock, &c., independent of the resistance from the shooter's shoulder. It may be said that such is not the case with the London proof, where barrels are proved after being put together. Yet such is the case, in a greater or less degree in all barrels; as I trust I am understood, that all double barrels have both barrels proved at one explosion; so that if there be two barrels, there are two explosions simultaneously, which is never the case in shooting.

That the present mode of proving is very deficient, there cannot be a doubt. Its deficiency is proved by the fact, that many guns which have stood the proof, burst as soon as ever they are used with sporting charges. To be brief, I have now before me a double gun, 13 bore, which I know was proved with 15 drachms of powder. This gun burst with 3½ drachms of powder and 2 ounces of shot; yet this gun is as sound to all

appearance, as any iron I ever saw. In short, there is scarcely a year passes, without some three or four persons having their hands blown off by guns that certainly have been proved. It is a delusion to imagine, that the quantity of powder constitutes the proof. I again assert, and the truth of the fact can easily be ascertained, that only a certain quantity of powder can be ignited in a given space, upon which is only a certain weight, and that has a given resistance to overcome.

The atmospheric air is also necessary to the ignition of the powder, as is proved by the fact, that coarse grained powder is stronger than fine; which can arise only from a larger quantity of air being included in the interstices of the coarse grain than of the fine. If by hard ramming this air is expelled in a considerable degree, the quantity of powder that would ignite will be diminished; yet this is a practice generally adopted, when loading the barrel for the purpose of proving it.

If any proof were wanting, that in a given space, a given quantity of powder will produce the greatest degree of explosive force, that proof is supplied by experiments with respect to artillery. It is well known to those versed in gunnery, that increasing the quantity of powder beyond a certain given charge, lessens the force of the explosion. They cannot project a ball to a greater distance by increasing the

quantity of gunpowder beyond a certain ascertained weight. In some guns, this ascertained weight is one-third the weight of shot. The proof charge of fowling-pieces is $\frac{14}{16}$ the weight, while the sporting charge in some instances is $\frac{3}{32}$. Such is the difference between scientific and random charges. If it be a fact, that no more powder will burn on firing a gun than one-third of the weight of the shot, why should $\frac{14}{16}$ of that weight be put in? On this fact I rest my argument, as it contains in a few words all the reasons I could advance, were I to write a whole volume on the subject.

The curious fact, that the *Monster Mortar*, used by the French at the siege of the citadel of Antwerp, burst on the explosion of a charge much smaller than it had been fired with before, has puzzled many to divine the reason of its bursting. It was occasioned by the same cause to which the bursting of the gun was owing, when the charge of powder was only two drachms, and the weight of the shot upon it, two ounces. The greater weight of shot caused a greater and longer continued pressure upon the interior, than when the weight of shot was less, and the quantity of powder greater. All mortars have chambers made to contain the largest charges that may be required. When they use only one half of the full quantity of powder, the unoccupied space of the chamber is not filled up, but left empty, so that the charge has twice the

space to ignite in, and the chamber contains four times the quantity of air than when filled with the charge. On the explosion of the powder, the air is at first compressed, but immediately expanding from the heat, it exerts a pressure upon the mortar more severe than that of powder itself. The force generated being scarcely strong enough to lift the shell, it is detained twice the time in the chamber; and the metal being kept expanded twice as long as it ought to be, is unable to resist the long continued pressure, and bursts. For, it is in the nature of some metals, that though they can resist (from their great substance) a sharp concussion, they cannot sustain a long continued pressure.

The fact that the shooting powers of a gun are increased by its being fixed in an immoveable position, is proved with the practice of mortars. Mortars on iron beds, and these firmly embedded in the earth, will throw a shell farther, though that shell is of a greater weight, and the mortar be loaded with a less charge of powder. than a gun on a carriage which can recoil. The same mortar will throw a shell farther when on the ground, than it will when placed on a platform, or on board a ship. It is for the purpose of destroying the recoil, that mortars for sea-service, though of the same calibre as those intended for land-service, are made three times the weight. Dr. Hutton states, that he found no advantage by retarding the recoil in practice with artillery.

He means, that no advantage is gained by stopping at three feet, a gun accustomed to recoil to the distance of six. The statement is perfectly true. If he were to allow a gun to recoil only an inch, and then strike against a solid substance, he would gain nothing. For if it recoil ever so little, the shooting force is as much weakened, as if it recoiled twice as far.

To increase that force, a steady fixed resistance is required. The velocity of the projectile depends on the force of the immediate impulse. Before a gun, suffered to recoil, could rebound from striking some solid substance in its recoil, the charge would be gone, and could, therefore, receive no additional impetus from that rebound. The truth of this fact may be illustrated by throwing a hand-ball against any loose body with sufficient force to displace it. However hard or elastic that body might be, the ball would not rebound from it, but would fall perpendicularly down. Fix and secure that same body, and then the ball will rebound with little less force than that with which it was thrown against it. So it is with gunpowder: if it meet with a firm resistance, it will rebound and project the ball or shot with additional force.

Thus I have endeavoured to explain my meaning with as much clearness as I am able. Should any doubt remain, any gentleman may easily ascertain whether I am right or not by the following experiment. Take any barrel, load

it by the proof scale, lay it on a piece of wood, place behind it a mass of sand, and fire it by a train; then ascertain the distance it is buried in the sand. Load it again, as you would do were you shooting, fire it as before, and I will be bound, you will find it buried as deep in the sand as with the proof charge. This experiment, I have repeatedly tried, and the result has been invariable; a proof that the sporting charge is as powerful as the proof charge. It may be asked, why these objections to the present mode of proving? Simply, on this account; over and over again have I seen barrels burst that I knew to have been proved. I was curious to know the cause of this, and was soon convinced, by repeated experiments, that the proof was rendered altogether ineffective by allowing the barrels to recoil. The forepart of the barrel is certainly put to a much severer proof by the present method, than it is ever submitted to in common shooting. This is owing to the great quantity of powder with which it is charged. As this travels up the barrel, it continues to ignite and explode; and were not the initial velocity increased by this succession of explosions, the pressure on every successive part of the barrel would be equal to the first pressure on the breech. No gun, however, bursts near the muzzle. Such an accident never occurs except by clay or snow getting into it, and sticking there; a piece will then fly off. It is at the breech, that the danger

exists. The first movement is the most dangerous.

If, then, powder is still to be used in testing the strength of barrels, the utmost quantity that can be burnt ought to be ascertained, no more should be introduced; and instead of a ball to fit the bore, two or three times the quantity of shot used on ordinary occasions should be placed upon the powder. Shot is of itself a severe test, consisting, as it does, of so many small bodies (and these not conducting bodies,) in one charge, and occupying such a length of tube, that when those lying next the powder receive the impulse, they have to convey it to the whole; and, in doing this, the lead is either so contracted, or the barrel becomes so expanded, that if not possessed of strength adequate to the resistance of the pressure, it is sure to burst. I have no doubt that it is the first two inches of the barrel that the shot have to travel, which first give way. If shot could be made of a substance more elastic than lead, I think it would be as little injurious to the barrel, while it would be equally destructive, and much safer to shoot with.

The present mode of proving being, then, liable to so many objections, may I be permitted to suggest the use of the Hydraulic Pump, as affording a much safer means of testing the strength of barrels. Every barrel should undergo a pressure at least three times greater than that which it is calculated to have to endure in shoot-

ing. Were this done, I have no hesitation in saying that the number of accidents would be very much lessened indeed. It may be asked, in opposition to this suggestion, is not the mode of placing the common barrels on an iron frame, with a body of iron to strike against, a sufficient method? I answer, no; though it is 50 per cent better than the other. The fact, however, is, that a greater degree of force cannot be generated, whatever quantity of powder is put into the barrel, than would be supplied by the explosion of a quantity of powder equal to one-third the weight of the projectile in any barrel of moderate bore (large bores are an exception, if of proportionate length). Now this quantity but little exceeds the strength of the sporting charge, and on the latter a weight 25 per cent greater is placed; hence the pressure must be nearly, if not quite, as great. Why it has not been customary to adopt the same method with respect to best barrels, I cannot imagine. The only reason the proof people give—that they are liable to injury by striking against the iron bar—is no reason at all; for were they placed perfectly close against the bar, there could be no blow, and, of course, no injury. Besides, if the iron bar is calculated to be injurious, could they not place instead, a body of lead, or tin, or copper. None of these metals would injure the barrels. There are, however, other reasons than those advanced. The provisions and penalties

of the act are not severe enough. Besides, the management of the proof-house is, for the most part, in the hands of gun-makers; their own barrels are there proved, and any regulation that reduces the losses occasioned by the bursting of barrels, is just as advantageous to them as to other makers—hence the wish to oblige the trade by not risking the barrels on the common rack or frame.

The provisions of the act are evaded in the following manner. I have already mentioned that the London Company passed a bye-law, requiring all double barrels to be soldered together before they are proved. This is without exception a beneficial arrangement, were it only strictly enforced. I know, however, that since so many of the London makers now get their barrels from Birmingham ready for stocking, many barrels are sent from the latter place to the former for proving, which, when returned, are taken to pieces, and reduced on the outside several ounces, and then re-soldered with brass, instead of, as they were before, with tin. This process, in addition to what they have already suffered by sweating, as it is called, reduces their strength still further to the extent of full 15 per cent; and if they have been hammer hardened, to 30 per cent. If they have been proved in Birmingham, they have generally to be reduced on the part intended for the jointing together, or inside under the rib, in addition to the double

injury they have already sustained by sweating and brazing. After this comes the boring of a full size out of them, by what is termed fine boring; and even after this, they are likely to be bored again to improve their shooting; so that if the sporting charge be only two thirds as great in pressure as the proof charge, the barrels are not all likely to bear it after all this sweating, reducing, brazing, boring, and re-boring, by which their strength *after proof* is reduced full 45 per cent—nay even to a greater extent, when we recollect that the barrel is put to a much severer test of strength by a sporting charge, fired from the shoulder, than by the proof charge, without any resistance to the barrel. There exists many other methods of evading the intention of the act. The following is an instance, showing to what lengths, for the sake of gain, men will go. A year and a half ago, a person was summoned before the magistrates for having got foreparts welded on to pistol barrels which he had had previously proved. This practice of converting pistols into gun barrels he had carried on for several years for the purpose of pocketing the mere difference of the cost between the proving of a pistol and a gun barrel.

The forging of the proof marks of the London and the Birmingham proof-houses is very common; and the forging is executed with such skill, and the imitation so exact, that the proof masters are unable to swear to the forgery of

their own marks. The penalty is so trifling, and the trouble and difficulty of conviction so great, that those guilty of the forgery, are rarely brought to punishment. There are persons in Birmingham, that would make you up a gun for nothing but the price of the proof as profit.

Hundreds are made, principally for the American trade, at no greater profit than sixpence or ninepence each gun. Why the Company is so remiss as to permit this to be done, under their very noses, I know not. I suppose it is owing to the Company having no wish to spend their profits in prosecutions. The lightness of the punishment inflicted by the legislature for this crime, affords certainly some excuse. The protection of his Majesty's subjects requires an enactment of much greater severity. I close my observations with a wish, that some intelligent and influential member of Parliament would take up the subject, and by an enactment of rigour and severity, put an end to the manufacture of articles, which will not, in the end, fail to destroy our reputation as gun-makers, and our trade also in that article—which constitutes a branch of commerce of great consequence to the people of this country; and the loss of which would be most severely felt.

CHAPTER XV.

ON PUTTING DOUBLE BARRELS TOGETHER.

The art of putting double barrels together seems to be but little understood, even by the first makers. It is a rare occurrence, indeed, to find double barrels properly put together, having neither too much nor too little inclination at the muzzle. I shall, therefore, take the liberty of making a few observations on this very important point; also, on the proper elevation of the rib. The trade have to thank Joe Manton for this, as one of the best inventions he ever brought forward. Were proper attention paid to the construction of these ribs, they would be invaluable, yet we every day see them bungled by blockheads in a way to make every judge of good work wish the bungler in Siberia.

Having then got your barrels ready to put together, and cut to the length you intend, it remains to be determined what inclination they should have. Be they long or be they short, they should, to be perfect, come to a point at a given distance, if for general sporting. If, however, you are putting together a large pair for wild fowl shooting, the inclination must be altered to suit the greatest distance to which it is intended the shot should be driven.

There is a great diversity of opinion as to the proper inclination of a pair of double barrels. It is needless to state the precise distance at which the converging lines drawn from the centre of each barrel, and indicating the inclination of the barrels to each other, should come to a point. If we take the point of convergence of those lines at $2\frac{1}{2}$ yards, it will follow that at 40 yards each barrel, were it fixed in a vice, would throw the centre of its charge six inches on the opposite side of the mark, or body fired at; but if the gun be fired from the shoulder, the recoil will invariably cause the gun to swerve outwards, so that at that distance, she will never fail to throw her shot in a good direction for the mark or bull's-eye.

The subject may be understood by the following observations. All tapering substances, when laid together, were the taper extended, would come to a point at a certain distance. Gun-barrels are made to taper towards each other, and some more than others. To make them uniform, it requires that they should be reduced or flattened to allow the thick or heavy end to joint closer, to allow that point of convergence to be extended to a greater distance. If then, we take two barrels, two feet eight inches long, and having a solid substance of metal at the breech of $\frac{3}{16}$ of an inch each, and $\frac{1}{16}$ at the muzzle; it requires the difference $\frac{4}{16}$ to be multiplied 45 times (there being that number of lengths in 40 yards) to ascertain what distance the points of

the different lines are from each other, which will be $11\frac{4}{16}$ inches, or $5\frac{10}{16}$ from the centre or line of sight. If you wish to reduce it from the centre, you have to join the barrels so much nearer at the breech; or should the inclination be too little, the muzzle must be jointed closer. As, however, all guns are now made very heavy at the breech, they very seldom require any closing at the muzzle, though it is customary to do it, and to a great extent; but it is owing to the ignorance of the nature of shooting.

Having satisfied yourself that your barrels are set correctly, the next thing to ascertain, is the proper degree of elevation. Different lengths require a difference in the height of the rib. A greater height is also required for a person accustomed to use a crooked stock; and less height for one accustomed to the use of a straighter one; and so on. Few barrels are to be met with in which the elevation is sufficient; a species of innovation much practised by gun makers of the present day, whatever merit there may have been in the original invention, there is none in "the improvement," as they term it. Take any of the modern barrels, and calculate what is the real elevation of them, and you will find it is not equal to the distance that charges will droop at 40 yards, when we consider the very large charges of shot that many are accustomed to use, without a corresponding quantity of powder. It remains then to be decided, what elevation a gun should have for that distance.

I have tried the experiment some hundreds of times with guns of all descriptions, both with a rest and from the shoulder, though standing as firm as possible; and by turning quickly round, and firing (as I might do were a bird to spring in a situation where I could get only a snap shot) against targets, such as are used in military ball practice, being about six feet high, and by means of which you could perceive where the body of the shot had struck. I have also fired against the steep sides of those beautiful sand banks of which we boast on our own immediate coast, and on which, from their smoothness, you could tell every shot that had struck them. Those sand banks I found much superior to sheets of paper for trying guns, the marks being all visible at once, so that it is easy to define the outside limits of the charge. As to the last method I have tried, no one whatever has, for the time I have had an opportunity of trying it, fired more shots, or, as it has been told me, wasted more powder and shot by firing on the water, both at living and dead marks. To sum up all, my conviction is, that almost all guns charged, as it is the custom, with heavy charges of shot, droop full twelve inches at forty yards, though by using small charges of shot you will find them to be thrown much more correctly than the heavy charges; so that it is possible to make a gun too high on the rib for a shooter that thinks more powder and less lead preferable to much lead and

little powder, for believe me nothing is more injurious to the shooting properties of any gun than too great a weight of projectiles. Powder may be compared to the strength of a man. Give him a stone four pounds weight, and desire him to throw it—mark its flight; give him one half that weight—attend to its flight; one will cut a segment of a circle—the other a parobolic curve, keeping a direct line until its initial velocity is gone, and then cutting a part of a circle, though it has gone twice the distance, and with twice the force; thus proving, that if weight is to be thrown with only a certain propulsive force, there must be elevation to carry it to the destination intended, though at a much less speed and force than if that weight were one half less. Thus a gun maker can only construct the elevated rib by guess, if the gun be not ordered, or the maker unacquainted with the sporting ideas of his customer. It is nonsense to lay down a scale of charge, and say, let the shooter stick to it. It were as possible to turn the course of the Thames as to convince some old shooters of the erroneousness of their ideas respecting the propriety of having large charges of shot. The obstinacy with which they continue to use very large sized shot is a proof of this. They will tell you that you talk like a child should you affirm that small shot, with a moderate sized gun, will kill equally as well as large. I can assure them that I can kill, and

have killed scores of times, the larger sea-gulls with No. 6, when they have gone away with two or three charges of Nos. 1 and 2 fired at them; and when they have been skinned I have found the large shot in a body of feathers just under the skin as large as a marble, while the small shot had not only cut clean through the feathers, but considerably through the body. I am quite convinced that moor puffings, or any other close feathered sea-bird, can more easily be killed by small shot, say No. 6 or 7, than by larger, if the gun be of sporting dimensions. But to return to the elevation.

It being difficult to determine, on any scale of elevation, while such a diversity of opinion on charges exists, I must endeavour to convince gentlemen of the superiority of my plan, which they will find fully treated on under the head *Shooting*. However, I think the elevation I have given, will be found to be as near what is requisite as possible, if we continue to load as heretofore; if reduced charges of shot be adopted, a less elevation will suffice. To ascertain what elevation at the breech, for the above scale is requisite, take the thickness of the breech and muzzle, and multiply the difference by as many times as there are lengths of your barrels in the 40 yards, and you will then ascertain what elevation they give of themselves; and to make up the difference wanted, must be the elevation of the rib, which may be calculated in the same

way as the barrels; the length of the barrels being the only way of obtaining a correct idea of the height required. If you should be making Woodcock guns, less elevation is required, the distance of shooting being shorter. In large guns, a greater elevation is required. I believe, however, Colonel Hawker has fallen into an error, when he says that long guns require a greater elevation than short ones. But does not a long gun keep the shot more together? Is not more force generated; and is not the initial velocity greater than in a short gun? If these be facts, why is more elevation required, if the shot do not droop? I apprehend, the Colonel means, if the same height be required to be given above the mark; nothing can be plainer than this—that if one pair of barrels be four inches longer than another, and the elevation the same, there cannot be as many lengths in the 40 yards of the longer barrels as of the shorter; and hence the difference, when multiplied. I think, therefore, he cannot have taken into consideration, the superiority in their shooting; for there cannot be a doubt, that, if a gun keep the shot together longer, it cannot require that allowance for drooping, which a shorter gun does.

There is another objection which I have to make to the present mode of putting barrels together, and then I shall dismiss this part of my subject. I object to making elevated ribs hollow.

Whether they are made hollow for the purpose of saving iron, or of making the barrels lighter, I never could learn, but I hold the practice to be highly injurious to the shooting of the barrels. If lightness be the only advantage, it is a trifling one, as it does not lessen the weight more than three ounces; and should any water in washing get into the inside through any imperfection in the soldering, it will not fail in a short time, to create such a rust, as will, sooner or later, inevitably destroy the goodness and safety of your barrels. It is on the score of lightness alone, that the practice can be defended. The shooting powers it cannot increase, being more liable to increase the expansion than if they were solid.

CHAPTER XVI.

ON PATENT BREECHES.

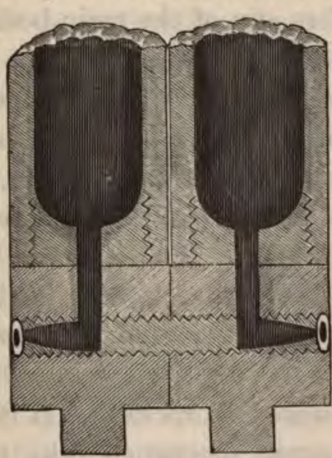
THE late Henry Nock, when he invented the Patent Breech, must have had in view the quickness of ignition, and the generating of a greater strength of explosive power than was usually produced in the common breech. This is effected by its keeping the powder in a looser state than that in which it was held in the common breeched gun, by preventing the compression of the powder by the wadding; for, the breech containing the whole charge, and being less in diameter than the barrel when the wadding is rammed down, it could be driven no farther than the end of the breech; so that, when the fire was communicated to the touch-hole, the charge would ignite almost instantaneously; I say almost, because it is not possible to ignite above a certain quantity of powder in a certain space; for, as soon as one quarter is changed by the explosion into the state of a gaseous fluid, so great is its elasticity, that it instantaneously fills all the space left; and the remaining portion of the unexploded powder is compressed into a body, which keeps igniting like the composition in a rocket, as it travels up the barrel; and here I must be

permitted to repeat what I have before stated, viz. that the reason why a long barrel will kill, or shoot better, than a short one, is because it burns more powder. Similar is the advantage which breech has over another. The form of breech one that would burn most powder, and of course generate the greatest quantity of force, is the desideratum wanted. It should also contribute to destroy the recoil, by presenting less of a direct resistive surface, and should, by its shape, throw forward the force that had struck it, assisting the remainder of the powder, as it explodes, to project the charge of shot.

The plans of patent breeches, which have been submitted to the consideration of the sporting world, are so numerous, that a large work would be formed by making a single observation on each. I shall therefore confine my observations to two or three different plans; and in doing so, I trust I shall be able so to explain the principle on which each patent breech is constructed, as to enable every reader easily to decide to which the merit of superiority belongs.

The first plan on the list, is that adopted by Joe Manton; not because it is the best, but because it is in almost universal use. For some reason which I cannot divine, every gunmaker has stuck to it. It possesses no peculiar advantage. It is certainly as good as many; but it is far inferior to others. Why a man of his ability chose to recommend it, I do not know. Puffed

and praised as it has been, I am too dull to discern any merit it possesses, except that of preventing a great escape of the explosive matter through the touch-hole; and from the extreme length of the small chamber, it is calculated to diminish greatly the escape of that matter in flint guns.



A FAC-SIMILE OF JOE MANTON'S BREECHES*.

In percussion guns this preventer is not wanted, as the cock of the lock precludes, in a great measure, its escape, by lying on the nipple. It possesses none of the properties that exist in the original patent. The cup is so small, that it will not contain half a bullet, the size of the bore, were that bullet cut across the centre. From the bottom of the cup there extends, until it comes on an angle with the touch-hole, a small chamber, or round hole, an eight of an inch in

* The darker parts in the cut, denote the form of chambers and anti-chambers.

diameter; from the termination of which a tape-hole runs on an angle, through the platina touch-hole, to the pan of the lock. Now, I should think, that both the cup and the chamber will not contain more at most than one-third; so that if we allow, that the powder in the chamber must be burnt before any of the main body, it follows, that there is a train of an inch and a quarter long to be consumed before your magazine is set fire to; which of course, must consume time. In contradiction to this, it may be said, that as soon as the powder in the chamber is ignited, it will fire into the main body. The assertion to a certain extent would be true, if that body was loose enough; but how seldom is this the case? What is there to prevent it being compressed as hard as if it were in a rocket? It is well-known what pains most sportsmen take to ram their powder and shot hard down, as if tight, hard ramming were a benefit. After so ramming, there is but little chance of firing into the main body, unless we are to believe that there is force enough in the quantity that fills the chamber, to move the whole charge of both powder and shot; of the impossibillity of which, I am fully convinced. The size of the touch-hole being full one-fourth the size of the chamber, I am sure that full that quantity of powder escapes by the vent; were that escape rendered impossible, the moment the fire was communicated a greater strength would of course be obtained; but that

is impracticable in flint guns, and only partly possible in percussion guns. In the former, there never was any means of prevention; in the latter, it is imagined that the cock prevents the escape. This, to a certain extent, I admit; but the explosion of the percussion powder always throws back the cock a little, and allows a portion to escape. To the question, How does this breech prevent any great escape through the touch-hole, when one-fourth of that which lays in the chamber escapes that way; I reply, that, when the magazine is fairly fired, the length of the small tube; and from the comparative flatness of the cup it forms but a small proportion of the surface, the exploded fluid filling the tube it is only a portion of what is in that tube, that so escapes.

The small quantity that escapes from this breech is trifling, compared with what escapes from breeches of other forms. That is the reason it has been so cried up. In what then, I ask, does this breech excel? Does it ignite more powder than the original patent breech? I assert that it does not. Wherefore then has it been adopted? Does it recoil less? On the contrary, more; it presents almost as direct a surface as the common plug. What then is the reason of its general adoption? Mere pride. A gunmaker, whose reputation stood so high as Joe Manton's, could not condescend to continue the manufacture of guns after the plan of any preceding maker, however excellent the plan of

that make might have been. By the bye, I wonder that some makers have not continued to make their guns with the common plug, and keep puffing it off as best. I wonder that they could ever submit to manufacture any guns bearing the most distant resemblance to the make of another manufacturer. So extreme is the fondness of these men for something new and original, that there is on record the instance of a gun-maker, "a great genius and inventor," who screwed his barrels into the breech, instead of the breech into the barrel. Some of the breeches thus constructed with such marvellous ingenuity, were blown off, to the no little injury of the user. This produced such a strong dislike to this ingenious invention, that the inventor was glad to call them in at any cost; so that the experiment, original and ingenious as it was, turned out to be rather expensive. By no means disheartened, this same clever inventor afterwards adopted a breech which only varied from the common plug, by having a chamber the same as that which I have just described; but instead of a cup, presented a surface quite as flat as a musket-plug. How this man, or indeed any other maker, can assert the superiority of their clumsy contrivances over the original patent breech, utterly astonishes me. They can never have tried it. That so many imitators are found, shows that the gun trade is at a low ebb indeed.

It is greatly to be regretted that the leading

makers should have always endeavoured to throw stumbling blocks in the way of every improvement that has not originated with themselves, instead of encouraging the efforts of inventive genius, and labouring to retain the ascendancy of the English gun-maker over the artisans of all the rest of the world.

The second plan, is an invention, or alteration, by Mr. Wilkinson of Pall Mall, which he terms a parabolic breech. Col. Hawker has not inaptly termed it the jack-boot breech; for the cupping of it bears a strong resemblance in shape to that useful article.

WILKINSON'S PARABOLIC BREECH.

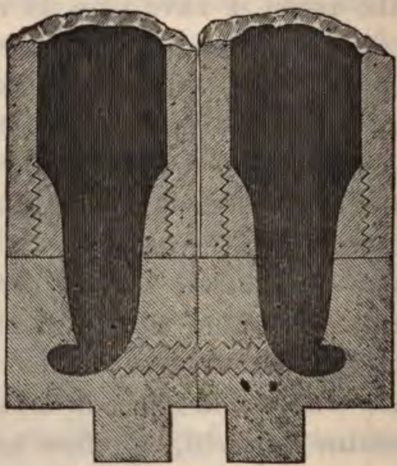
The shape is good up to that point which we may venture to call the top of the calf of the leg, at which point it is contracted considerably. This contraction he deems an improvement; as it tends, in his opinion, to detain the powder longer, that more may be burnt. This might (I beg pardon for the observation) be much more easily effected by increasing the friction in the barrel, or adding to its length. It is impossible, that the powder in this chamber, when ignited,

can give the same force to the projectile, as if it had no other opposition, than what that projectile gave, together with the friction of the barrel. It is impossible that powder, ignited in a given space, can become contracted, and pass through a less space with the same force with which it would, were there no obstruction. It may be compared to charging a bomb-shell through the fuse-hole with the loading of a large gun, and then putting that shell where the powder should be, and boring a communication through the touch-hole to the powder in the shell, and then ramming the shot belonging to the gun against that fuse-hole. When the powder became ignited, you would not, I suppose expect the shot to be blown out with the same force as if the powder had been put in in the usual way. The powder would escape the same as air would do from the globe of an air-gun, when the valve is opened and kept there; or as I have known it happen repeatedly, when shooting ball, the gun has got so foul, that it became difficult to drive down the bullet; so that when the gun was fired, the ball was so fast, that the charge of powder (being small) could neither move it nor burst the gun; and of course, all escaped by the touch-hole. In short, it has been tried at Woolwich, with a cannon that had been struck by a ball, while loaded, and the bore bulged in before the ball. Such guns, according to the regulations, are never fired after such an accident occurs, but are sent home to be recast. The old

powder was extracted by some means through the touch-hole, a pound of fresh powder was then introduced, and the gun fired by a match; the whole escaped back through the vent without moving the shot; two pounds were then tried with the same result, and so on to six, which was the utmost she would contain; and even that quantity failed, either to burst the gun or move the shot. Thus proving, that powder can be held in abeyance, if you have the means. It is, in a measure, held in abeyance, in this breech. It cannot, therefore, be calculated to shoot strong; and is undoubtedly objectionable. According to my ideas of the nature and principle of gunpowder (which have been formed after trying a great number of experiments,) it is also calculated to increase the recoil to a great extent, as well as destroy very much the force of the powder. As a proof that it increases the recoil, I have seen the cock blown up to full cock, with the hole in the nipple as small as they are ever made; I have been told by persons who use this breech, that this occurs three shots out of every seven. This would never be the case, did not the powder find an unusual difficulty in escaping the usual way.

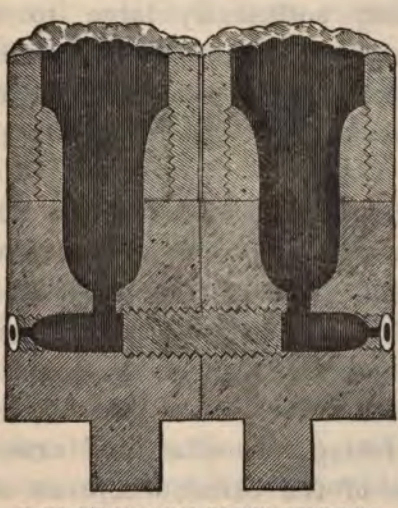
I shall now describe the sort of breech that I would recommend; aud then proceed to detail some of the experiments I have tried. I am not one of those, who would reject an invention, that is good, because it is old, or refuse to admit its merit, simply because it was not invented by

myself. It is sufficient for me, that it is a good invention, however old it may be, or whoever may have been its inventor. For this reason, I shall stick to the original patent breech without, however, adopting its objectionable parts. I am satisfied too that it has been discarded without any good reason. The only faults I can find in its construction are;—first, that the avenue, (as in the parabolic breech,) through which the powder has to pass is smaller than the anti-chamber in which it lies. Secondly, I object to the uniformity of diameter in its chamber from the bottom, which is a half round, to the top, on which the wadding lies. In my opinion, it would be an improvement, if it were made gradually to increase in dimension from the point, where the powder is first ignited to that part where the breech joins the barrel inside, somewhat in the manner depicted in the subjoined wood-cut.



W. GREENER'S IMPROVED BREECH.

To make the difference easier understood, I have here added a cut of a pair of original patent breeches.



H. NOCK'S ORIGINAL PATENT BREECHES.

In this improved breech, as the powder becomes ignited, the room for expansion increases. By thus increasing the space opposed to the fire, it is calculated to burn a greater quantity of powder, than one, in which the bore is of a uniform size the whole depth of the breech. I should not exactly recommend that a breech should be so large as to contain the whole of a charge; as I know accidents have occurred from this circumstance, when a smaller charge has been used then would fill the breech. The space unoccupied by powder is, of course, filled with air, which, when expanded by the heat of the explosion, is apt to increase the risk of bursting the gun. Many

guns have burst from this cause. In order, therefore, to provide against the occurrence of similar accidents, I would have the breech constructed only sufficiently large to contain a moderate charge; and, in the mean time, I have only to request those who subscribe to my doctrine to avoid tight ramming the powder in loading.

My first, and, of course, rudest experiment on breeches was, fitting into a long Old English barrel several pieces of iron, about an inch and a half long. Each was bored to represent different shaped chambers. One of these pieces of iron was put into either end of the barrel, with the chambers facing each other, and rammed up to the middle of the barrel, where an obstruction was placed to prevent either from being driven further than its allotted place. Between them was introduced a quantity of powder, through a hole in the side of the barrel, which also served for a touch-hole. Now, my idea was, that the shape which presented the most direct space to the explosion, would be thrown furthest. I had real pleasure in finding my anticipations confirmed by the experiment; although both were of equal weight, and though I reversed their situations in the barrel repeatedly, for fear of any inequality existing I found that one was invariably thrown, sometimes as much as twenty yards, further than the other. I repeated the experiment, until I was perfectly

satisfied of the superiority of one form over the other. During these experiments I satisfied myself of the advantage gained by cutting off the recoil, which I have elsewhere mentioned. This mode of experimenting, not being quite satisfactory to some of my sporting friends, who did not view these experiments as conducting to the same conclusion that I adopted, I determined to put the truth of my opinion to a further test. I therefore had a rifle-barrel made with four breeches, one resembling Joe Manton's; another, the parabolic breech of Wilkinson; a third, H. Nock's original patent; and a fourth, of that form which I have already described as being, in my opinion, the best; and, as I was resolved on an experiment that should be decisive of the superiority of one of these forms over the others, no pains were spared to have each breech constructed as perfectly as possible. When this was done to my mind, I had two triangular rests made, with beds on the top, to receive one the muzzle of the barrel, the other that part of the stock just before the guard of the trigger, and which, when once placed, secured the rifle by two screws. The balls being cast, and the charge determined upon, I adjourned to that beautiful level sand on the shore of the sea in our own immediate neighbourhood, and which, though nearly two miles in length, is nearly as level as a bowling-green, having only a gentle slope to the sea. Here I pitched my rests, and secured

my rifle in a position perfectly horizontal, by a spirit level, at the height of five feet. I tried Joe Manton's breech first, and the average distance at which the ball came to the ground was 208 yards, the extreme distance in the whole twelve shots not being 215 yards. The barrel was then washed out, and Wilkinson's breech put in, and the rests were then removed ten yards a side, but to a spot perfectly parallel to that on which they stood at first. Every thing being adjusted with the same minuteness as before, twelve shots were fired, and the average distance was found to be 189 yards, and the extreme 203 yards. The same minute particularity was observed with Henry Nock's, and the average distance was found to be 236 yards, and the extreme 245 yards. I then prepared with confidence for the last experiment, and had the satisfaction to find that it completely verified my most sanguine expectations. The ball was thrown to the distance, before it touched the ground, on the average 247 yards, being 11 yards further than H. Nock's, 38 yards further than Manton's, and 58 yards further than Wilkinson's. In these experiments my only wish was to satisfy myself and my friends, as to the best form of breech, and, I am happy to say, I succeeded in producing in their minds the fullest conviction. I have now laid the result before my readers, and trust they will not suffer their prejudices to triumph over their reason, by re-

jecting my conclusion without first trying my experiments. If it were required I could produce a number of vouchers for the correctness of my assertions. I can assure the reader, that I took the same trouble in loading with a charger on the ram-rod (to prevent any waste of powder,) as if I had been contending for a wager of a hundred guineas. And I am perfectly convinced that the form of breeeh which I have recommended is decidedly superior to any other form now in use.

Were any other proof wanting, it is supplied by the experiments on chambers, conducted by the orders of the Board of Ordnance at Woolwich. Colonel Adye says, it is found that the conical chamber with a circular bottom gives the longest range under all circumstances; and as Col. Hawker truly observes, there is nothing like trying experiments on a large scale, I have tried the common breech cupped out in various shapes, and when it approached this, it was always found to shoot strongest. I have also tried the common plug, but never found it approach even to the worst plan of improved or patent breeches. I have also, in rifle shooting, tried several breeches with a flint-lock ; and though Manton's breech does shoot nearer the other two, yet it is inferior. I can assure my friends, who are attached to the flint-lock, that their idea about it shooting stronger, is a mere fallacy. In a rifle, it does not shoot so far by

15 per cent, with rifle charges. But when I come to speak of rifles, I will explain myself fully on the subject.

In conclusion, I trust I have shown that the breech which I recommend to my readers possesses all the qualities required, viz. strength and quickness. If, however, they are not convinced of its superiority over those in use, I can assure them I am; and I shall not forsake it until I find a better.

CHAPTER XVII.

ON THE FLINT AND DETONATING SYSTEMS.

THE use of flint-guns is now so nearly exploded, that it is scarcely worth the trouble to explain the principle of their construction. Indeed, had not the assertion been so repeatedly made by writers, that flint-guns shoot stronger than those made on the percussion plan, I would not have noticed them at all. These gentlemen, who are so "positive, clear and strong," have never deigned to tell us on what reasons they ground their opinion of the stronger shooting powers of the flint-guns. To me, it appears that, these gentlemen do not understand the principle and nature of percussion. They broadly assert, that percussion will not burn the quantity of powder that flint will; but for this opinion, they offer a very lame reason. They say, that it tends to drive the powder out of the barrel, unburnt. It does not. The difference between a flint and a percussion gun is this: if you lay a train to a barrel of gunpowder, it would be slower in exploding, than if you were to put a pistol to the bung-hole and fire into it. If the charge in a flint-gun takes half a second in exploding, that in a percussion gun will not take more than a quarter of

a second, consequently the flint must burn more; as the fact is, that in all explosions, time is the regulator for the quantity burnt. It is nonsense to suppose, that the strength contained in the powder in a percussion cap can have any power to move the charge in a barrel. I had a rifle constructed with two breeches, cupped perfectly alike, and two locks, one flint, the other percussion; and in all my experiments with this rifle, I found that with moderate charges, the percussion gave the greatest range; but when the charge was increased to the extreme, the flint gun gave eleven yards farther, on the average. From these experiments, I came to the conclusion, that where the charges were less than either could burn, the percussion was undoubtedly better than the flint; but if the charges were more then either could consume, the flint was better than the percussion. The reason is this:—when the charge is small, a tenth part of the flint-gun's charge escapes through the touch-hole, and, consequently, she cannot have the strength the percussion-gun has, where there is no escape for the explosive matter. There is, however, no question when the charge is larger than either can burn, the flint-gun has the advantage from the greater length of time her charge remains in confinement, and which, consequently, secures the burning of a greater quantity of powder.

The nature of gunpowder may be understood by the following observations. A certain quan-

tity of powder will burn in a certain space, with a certain weight upon it; that quantity possesses a certain strength: the degree of strength generated may be increased by increasing the weight or friction to a given extent; but then the extra strength obtained will not be commensurate with the extra weight; and, of course, the speed will be much diminished, as the space will always be a regulating power. In a flint-gun, when the powder is ignited, it keeps rushing out of the touch-hole, there being no hindrance that way; and the train, as we may term it, has to keep burning, until a much greater degree of force is generated than can escape through that vent, or a sufficient power is created to move the body of the charge. In the percussion-gun, as soon as the fire is communicated, the touch-hole is partially closed, and an obstacle presented to the escape of the powder that way; so that a force equal to move the charge is generated in one-half the time. It is this circumstance that constitutes the difference between the flint and the percussion-gun.

There is another mistake that writers on the percussion-gun have fallen into. They tell us, that the flame from percussion will penetrate through a considerable quantity of powder, without igniting it. To prove this a fact, a machine has been invented. This is the greatest of all the delusions they have fallen into. Chemists inform us, that the heat from percussion-powder

is more intense than the heat from ignited gunpowder. Will they then assert, that the flame from from gunpowder would pass through gunpowder without exploding it? The assertion would be ridiculous. It cannot fail to ignite it when the powder is up to the top of the nipple. That it should not do so when the gun is not properly charged, is not at all wonderful. There is here, however, an optical illusion. It is the gas or foul air generated, which bears the resemblance to real flame, from the reflection of the other. The flame of the percussion will never penetrate amongst such a solid body as powder is when lying in the breech. I have tried many experiments to ascertain this point, and have invariably found, that if the powder was not up to the top of the nipple, but only, or scarcely so far as the bottom of the screw, the gun would miss fire. I have filled the small anti-chamber, directly under the nipple, full of powder, and fired a cap: on examination, I found that it had blown the powder, unburnt, up the barrel. I have filled it again, and rammed the cup in the breech full of oakum, and then fired; the powder still remained unburnt, though the gas, from the explosion had blown it in a body against the oakum. I again filled the anti-chamber with oakum, and on it put a small quantity of powder, which just filled up to the bottom of the nipple; and still I found that, though the explosion could not move the tow or

the powder, it had not ignited it. It was not until the powder was nearly up one-third that an explosion took place; and then it was only occasionally. I could not obtain an explosion with certainty, even when the powder was one-half up the nipple. It could only be obtained with certainty when the powder filled two-thirds the nipple. Now these experiments completely prove that the percussion does not possess the powers attributed to it. Its effect is not greater, or at least very little more, than would be the effect of ramming quickly a piece of red-hot iron into the touch-hole of a flint-gun, and keeping it there, if possible to prevent the escape of the explosive matter. The effect would then be quite as great, if the vent was completely stopped; Wherever there is any communication of the nature of a train, the explosion must of necessity be slower than where more rapid means of ignition are employed. Percussion does not penetrate any distance, where there is any other obstruction than air. No doubt it has the appearance of great force, but there is, in reality, no great force. The appearance of force is owing to the gas generated, being by the explosion driven into the nipple; and finding no obstruction, it creates a concussion on the air in the barrel. If the chamber be filled up to the top of the nipple, with powder, its immediate ignition from the percussion prevents this effect, as the whole space is instantly filled with

a much greater force than the explosion of a percussion cap is capable of generating; and all the gas, if it cannot escape back by the nipple, remains there confined, and does not penetrate further until it is relieved by the general explosion. But why do I keep contesting this point, when every sportsman has had the truth of my assertion proved to him by his own gun. There are but few sportsmen, who have not had some miss-fires in a season. I therefore ask, is it not common when a miss-fire occurs, to shake the gun, for the purpose of bringing the powder up the nipple. This practice being found to answer, is it not a positive proof, that the percussion fire never penetrates so far as the powder, near as it is from the top of the nipple? That it is near, there cannot be the least doubt, or it could not be brought up by a single shake of the gun.

The London makers still make all their guns with vent-holes; but why they do so I cannot tell. It cannot be to prevent a miss-fire, as it is decidedly the very thing to cause it, by allowing the air, when ramming down the wadding, to escape through it, and thus keeping open a space that should be perfectly closed. As to allowing the gas to escape that way, it cannot be, for if the nipple be filled with powder, it cannot get to that distance, and cannot therefore escape, except when a miss-fire occurs; and I imagine the existence of such a vent would not then be considered an advantage. In favour of the vent

hole, it is urged that a gun recoils very much without one. True; but then why does it not recoil so much with one? Because so much of the explosive matter is allowed to escape through the vent, and thus the percussion gun is reduced to a level with the flint.

To prevent the frequency of a gun missing fire, I have invented a new nipple, the superiority of which to the common nipple, half a dozen trials will completely prove. The top of the nipple is made with a conical cup, extending a trifling distance down. At that point, the smallest part of the hole is to be found; from thence it keeps gradually expanding inside to the bottom. A cut of the old and the improved nipple is given below, by looking at which the explanation will be better understood.

OLD PLAN OF NIPPLE.

IMPROVED PLAN OF NIPPLE.

Around the top a space or margin is left on which the percussion takes place. All the powder contained within this rim in the cap, is fired and driven down the cone into the chamber. With this nipple I find, that I can ignite powder at the bottom of the nipple; while in the old nipple no such ignition will take place. The following experiment will show the force of it

I cut a piece of cork to fit the muzzle of a gun-barrel, and charged it with a quarter of an ounce of lead, to cause it to give a greater resistance to the air, and when a cap was fired on the nipple it would just blow it out. I then put in the newly invented nipple, tried it, and the cork and lead were blown six yards from the muzzle. Oh! I think I hear the exclamation, "What! more force to blow out the powder unburnt!" No. But if my reader still remain unconvinced, I will tell him of other means by which I was satisfied that the gas from percussion was blown out as soon as in. About two years ago, I was fortunate enough in one sense, though not in another, as my pocket knows, to invent a mode of firing cannon by percussion. The method was this: a tube the same as is now in use, was charged with percussion powder; and instead of the cup on the top, a piece of iron was attached, on which it was usual to put a cap. The tube being perforated, and put into the vent of the gun, a small hammer is taken, with which it is struck, and the gun exploded. Now, when the gun is loaded with a shot, it is ten to one but the hammer is blown from your hand by the explosion. From a conversation with a general officer I learnt, that if it were possible to place a twenty-four pound shot on the vent, and fire the gun, that it would be blown a distance into the air. If such be the case, what chance has the weak percussion flame to force itself into a

body of flame, that can produce such effects as these? No: there cannot be a doubt that the percussion flame is forced back, the instant the first powder is ignited. What can occasion the cock to be blown up to half-cock, but the force of the powder driving back the gas? By the improved nipple I find, that the caps are not near so liable to fly, owing to the explosion taking place in the cone, and the rim of the nipple filling the top of the inside of the cap. In the old plan this was not so. The nipple was tapered at the top suddenly, and the percussion took place close around the small hole. The consequence was, that all the powder contained in the remainder of the top was exploded, where it could not benefit the powder in the inside; but, on the contrary, tending to increase the chance of the cap flying, and the risk of breaking the mouth of the cock. The new plan, provided the cock be properly fitted, and bear equally on all parts of the rim, has scarcely any explosion on the outside.

As I decidedly object to a vent-hole, I may be asked, if I have any other method of allowing the air that is forced down by the wadding, to escape. To those who object to having a hole in the wadding, that is put on the powder, I recommend that they should have a slight nick made on the rim of the nipple, which will be large enough, if it will allow the smallest needle to lie in it. I would also recommend a moveable

screw, where it is customary to have the vent-hole at present, but without any such perforation, merely to allow you to extract short corn, which sometimes get into the chambers and cause miss-fires. The cocks I would have invariably made with moveable heads, well cupped, to prevent any matter flying, and of the best tempered steel. It would be also advisable to have spare ones, as they are apt to get holes beat in them by constant usage. The shape of the cock, and the form of the finish of the breech being entirely matters of fancy, they require no remark, save, that care should be taken to leave a fence or protection on the false breech, to prevent the eye being injured by any detached part flying.

CHAPTER XVIII.

ON FALSE BREECHING AND JOINTING LOCKS.

As this is but a mechanical operation, requiring little except good workmanship, but few observations are necessary; as a good practical workman will know all I can advance, and sportsmen can take little interest in the subject. One thing I shall take the liberty of mentioning is, that to increase the strength of shooting, the false breech should be well jointed, all parts being equally close, and the bearance as great as you can make it, with a due regard to the strength of the huts of the breeches and to the neatness in jointing your locks, so that the gun shall not be disproportionately wide between the locks, as great stretch of hand is then required to cock the left barrel. Besides, the more you can succeed in getting the nipple on the centre of the breech, so much more direct will be the communication with the charge of powder, it always being an advantage to cut off the angles between the top of the nipple and the charge. In jointing the locks, I think it a decided advantage, whether they are back-work locks or

bar side, to have them to joint as directly behind the false breech as possible; so that, by supporting the false breech, they tend to lessen the recoil communicated to the stock, and unquestionably to increase the strength of the shooting of the barrels.

CHAPTER XIX.

ON THE LOCKS.

I HAVE always felt as great a pleasure in handling a gun with a pair of good locks, as some would experience in listening to the musical productions of the great Handel. There is to me a superior music in the tack of the scear on the tumbler, and the fine elasticity of the main-springs, moving with a sort of fine oily feel, though light, as sharp as the lightning playing in the heavens. There have been many good lock-makers and there yet are many; but still they have, I fear, decreased much of late. From the great demand for second-rate goods, they are rarely called upon to make a first-rate article; and thus, from being so little accustomed to make any but inferior locks, they, of course, are out of practice. Instead of the manufacture of the best being more encouraged, it is becoming every day more rare to meet with a good one. There is a great degree of skill displayed in the making of locks, though to the casual observer it does not appear. On the simple hanging of the swivel, depends all the sweetness of the play of the main-spring; and on the placing the hole for the scear-pin, depends the sweetness of the scear playing on

the tumbler. Many who now pass for excellent workmen would find this a difficult undertaking, simple as it may seem, without a pattern by which to work. All locks for percussion should have the greatest strength of main-spring at the moment they strike the nipple, or, what is termed, when the lock is down. On the pitching the scear, depends the cutting of the bents, and on their formation, the danger of the lock catching at half-cock, when the trigger is made to pull easy; but these observations will be understood by a lock-maker better than I can explain them.

The quality of all locks depends on the price they cost filing, and without you pay the workman a proper remuneration, you may rely on having them somewhere inferior, or in accordance with the price, which it requires a workman to point out; so that, without a doubt, any person, if not a first-rate judge, is completely resting on the honesty of the workman.

There is a family in Wolverhampton who have obtained great reputation as lock-makers, and I must say deservedly. It were almost needless to mention their names, as they are to the trade, at any event, well known; I mean the Braziers. They have been lock-makers for thirty years, and their father forty before them. Their locks are certainly the most perfect pieces of machinery made at the present day, though they will have their price, their firmness for

which has given rise to many impositions on country makers, by the Birmingham travellers imposing as Braziers' locks what they never saw, and thus pocketing twenty shillings a pair. Therefore, the only sure way is to get them direct from themselves; and I will be bound, if either brother state them to be of best quality, you may take his word, as their reputation, as honest tradesmen, stands high. There may be, I have no doubt, as able workmen as themselves, yet so addicted are the gun-trade in general to the sin of drunkenness, that only one out of twenty can be believed on his oath; as the generality would cheat their fathers to obtain the means of indulging that evil propensity. When they do get started to work, if you go to one and say, "Tom, now I want a pair of the best locks you can make;" he will say, "you may depend on having them; trust to me." Well, as soon as he commences, he is determined that they shall not be the best; for he has drunk so many days, that in order to keep his family out of the workhouse, he must have so much work done, and, of course, so much money by Saturday night; and thus locks, which should have taken him nearly a week to make, are completed in three days. Thus it is with many of the trade; they can make a dupe of you in spite of all your exertions, and it follows, that, when an honest man is found, he is patronised. An immensity of locks are made, for which the filer has not

above sixpence each, and some less. In Birmingham, if you know how to go about it, you may buy them sometimes at almost half-a-crown a bushel; so low have they brought the manufacture of the gun-trade. Locks, with steel scears and tumblers, which a few years ago were only found in best locks, can now be bought at three shillings and sixpence a pair, and so on, up to between three and four pounds a pair; but so good is the outside appearance of all locks between twelve shillings a pair and four pounds, it requires a good judge to ascertain their quality.

CHAPTER XX.

ON STOCKING AND SCREWING TOGETHER.

THESE are strictly speaking two branches, which only require on the part of the workman mechanical skill, the master ordering the stock to be of such a crook and length, as suits his customer; and, by means of a stock-gage, it can be made to within a hair's-breadth of such order. The crook and length are, as I said before, the gun-maker and sportsman's department; and so much depends on fancy, or, plainly speaking, prejudice, that it is rare that the former has a voice in the arrangement at all, though there is as much skill required in fitting a stock to the capacity of the different forms of arms, shoulder, and length of neck; as in fitting a vest, or a dress-coat, to please a dandy. If a few of our would-be-shooters would attend to what I shall here say on the subject, I feel confident that they would obtain more skill in shooting in a month than they have done for years, while following the bent of their own fancy. The majority of young shooters that I have met with, ruin their shooting by using stocks much too crooked and too short. They generally fix upon a stock in a gun-maker's shop, after handling a gun, that, they say, mounts ele-

gantly, and insist by all means, that their gun shall be made the same. When they come to use it, the performance is of a meagre description, and the gun receives the blame. All guns should be made as long in the stock as the shooter can, with moderate trouble, mount to the shoulder. I say, with moderate trouble, because, if there be no inconvenience, the stock is too short, and should be lengthened. No person, wishing to become a good shot, should hesitate at a little trouble; for without it, I can assure him, his object cannot be obtained. Having got the stock as long as can be mounted, take her out, toss up stones two at a time, blaze away your powder and shot at them, and you will soon find that you can mount your gun with ease, and that you can manage to hit frequently. Persevere, and you will soon obtain perfection, if with your long stock you pay attention to the directions given, in so able a manner, by Colonel Hawker, and others, on shooting. I would advise all young shooters to begin with a long stock, because the muscles of the arms being more extended, the gun is pressed more firmly to the shoulder, the recoil affects less, by receiving a greater resistance, and the gun follows in unison with the eye, until fired at the bird. Directions about observing whether the sight is on a line with the bird or not, are all nonsense; a real good shot never sees the sight; it is a nuisance to him; when the bird rises, the eye is

fixed on it; and, if the gun at all suits the shoulder of the shooter, it is sure to be in a line. You should never keep looking about to find the sight, but as much as possible practice without it, and never wait for a bird when the gun is at the shoulder, but fire, and don't despair because you miss. Find out all quick-flying birds, swallows of all kinds especially; and if you are near the sea-side, you will find excellent opportunities amongst all kinds of the sea-swallow, or terns, and never hesitate, though they are flying at a hundred miles an hour. In rifle-shooting the long stock is invaluable, it is so steady; in short, any one that has used a long stock for a time will rarely relinquish them. All that is required in mounting, is to throw the arms well out, and when the gun is high enough, draw them well in and smartly, and the gun comes to its place as neat again.

Nothing appears to me more clumsy, than the way some sportsmen lift their guns with their arms bent double. It also requires as straight a stock as possible, though that can easily be accommodated to the eye by adding additional height of rib on the barrels; you, by that means, can allow as much in the crook as you have added on the rib. I never could perceive any benefit accruing from what is termed, throughing of the stock; namely, casting the butt off to one side, to allow the face to be more directly behind the barrels: I should think it has a tendency to make

a person shoot to one side, unless he be very broad across the shoulders indeed. In screwing a gun together, (fitting on the furniture) care should be taken to let in the trigger-plate, so that the triggers should bear on the scears near to the extremities of their blades, otherwise they will spoil the action of the best locks in the world. If at the proper spot, the pull of the trigger is much sweeter by the leverage being greater. This was one point, which obtained for Joe Manton's locks such a name; he took more pains with this department than any other man in England.

Walnut has for many years been considered the most handsome and the best wood for gun-stocks, and no doubt is so yet. It is a wood, possessing much of the conducting principle, and therefore, not so calculated to lessen the recoil. Bird's-eye maple possesses the least of this principle of any wood whatever, and on that account, is best calculated for gun-stocks; yet it is considered too gaudy, and by some too brittle, though some years ago many of the London makers used it to a great extent, no doubt owing to the great price good walnut was selling at, caused by the immense consumption during the late war. It may not be unnecessary to remark, that in stocking and screwing together, all nails or screws should be made from the best description of shear-steel; and, when finished, tempered the same as a spring, as they are not so liable to

become injured in the slit by a bungler attempting to screw them out, and there can be no question of their superior strength, over those made of iron merely case-hardened. The fitting of these nails into their respective situations, forms as good a test of the quality of workmanship as any other part whatever; as a nail should always fit into either wood or iron the same as if they had been polished in with oil-stone dust, like the plunger in an air-pump. When thus fitted, they are calculated to resist any thing short of their greatest strength to break them.

The finishing department is, of course, merely a mechanical operation. And being thus divested of any principle that can interest sportsmen, would be at best a waste of time and paper. For the benefit of amateurs, I shall just mention the best methods of staining walnut and American maple stocks. After having got them dressed and sandpapered as fine as you possibly can, for walnut, take a composition of unboiled linseed-oil and alkanut root in the proportion of four ounces of the latter, to half a pint of oil. These, after being amalgamated for a week, will be a beautiful crimson colour, and will not fail to make walnut a handsome brown, on being laid on three or four times with a sponge.

The method I adopt to stain maple is this, I mix an ounce and a half of nitrous acid, with about the same quantity of iron turnings or filings. After the gas has evaporated, which is created by the

mixture, take a piece of rag, and dip it in the liquid left, and wet all parts of the stock you wish to stain. Let it stand until it is quite dry, then lay on a slight coat of the oil and alkanut root. Take a quantity of joiners' shavings, set fire to them, and pass the stock through the flame until it becomes quite black, or the oil is quite burnt off. Re-sand-paper it, and you will find it, if possessing any figure, a beautiful mottle. Add a few more coats of oil, it is then ready for varnishing, or any other way you may fancy to have it finished.

CHAPTER XXI

ON THE STAINING OF BARRELS.

I WILL now endeavour to explain to my readers the mode of staining gun-barrels. There exist innumerable recipes, and in fact almost every maker has his own method. The first I have found to answer uncommonly well, and which it would be a difficult matter to excel. It consists of the following ingredients :—

1 oz. Muriate Tincture of Steel.
1 oz. Sp. Wine.
$\frac{1}{4}$ oz. Muriate of Mercury.
$\frac{1}{4}$ oz. strong Nitric Acid.
$\frac{1}{8}$ oz. Blue Stone.
1 quart of Water.

These are well mixed, and allowed to stand a month to amalgamate. After the oil or grease has been removed from the barrels by lime, the mixture is laid on lightly with a sponge, every two hours, and scratched off with a steel-wire brush every morning, until the barrels are dark enough; and then the acid is destroyed by pouring on the barrels boiling water, and continuing to rub them until nearly cool. The Birmingham people brown their barrels of inferior quality in the following way to make them look equal to the best. They dissolve as much muriate of mercury as can

be dissolved in a dram-glassful of spirits of wine; this solution is mixed with one pint of water, or as much diluted as the person requires. A little of the mixture is poured on a little whitening, and laid on the barrel with a sponge, rather light; as soon as dry, it is brushed off, and a fresh coat is laid on; and so on till dark enough, which is generally in about two days. The effect the mercury has on every one of the joints of the fibres is wonderful, it never failing to make them, in two or three days at most, a beautiful brown, while the other parts being harder, remain, comparatively speaking, quite light. The rust is killed by hot water, but after that, the barrels are suddenly immersed in cold water, which has the effect of heightening the brightness of both the colours. Its appearance is beautiful, and equally as fine to the eye as stub-barrels browned in the same way, though it is mostly used for the charcoal iron and the threepenny iron barrels. The only method, in which there is no deception, is the smoke brown or stain; and, plainly speaking, this and no other is the reason the gun-makers condemn it. As the acid is decidedly weaker, and of course least liable to impart injury to the iron, by it no barrel can be browned to look well and fine but the best; or in other words none, save those possessing steel in their composition. Persons so much in the habit of using or passing off as stub-twist, charcoal iron barrels, of course find

by it a complete stop put to their impositions; hence their eagerness to cry it down. But let sportsmen only insist on having no other, and they will do more to improve the make of guns, than all I can write.

The method of staining is this; the barrels are anointed with a little vitriolic acid to cause the iron to receive the effect of the gas more readily; it is then washed off, and the barrels rubbed dry. The forge fire must then be lighted, and blown up with coal possessing as much hydrogen gas, and as little sulphur as possible. When the coals are burnt, till they give out a clear white flame with no black smoke around it, pass the barrels gradually through that flame backward and forward, until the whole are covered with a black sooty covering. Place them in as damp and cool a cellar as you can procure; allow them to stand for eighteen hours, and, at that period, if the place is sufficiently damp, you will find the iron parts covered with a red rust, while the particles of steel still retain the original sooty coat. Scratch them off with a steel brush, the same as by any other method of staining; take a piece of linen cloth, and wash or polish them with water and a little washed emery, and you will find the steel its original bright colour, and the iron a shade darker, with the outlines of both distinctly preserved. Rub them dry, and again pass them through the flame precisely as before; but above

all things be careful not to allow them to remain in the flame, till they become hot enough to melt the solder. When you have once passed them through, do not be in a hurry to pass them again, but in both be guided by moderation; neither allow them, after the first time, to stand to rust more than twelve hours each time; polish them as before, and you will find them a shade darker every smoking.

Thus persevere, until they become as dark as you wish to have them. The utmost you can obtain is a fine purple-black colour on the iron; the steel a shade inclined to a copper colour, but if you pay proper attention to the polishing, it will not change much from its original colour.

Be careful not to use emery of a coarser nature, than what is termed washed emery, viz. the very finest. If you cannot obtain it by buying, you may wash it yourself. Procure what is termed flower-emery, mix it with a bowl of water, and stir it well round; let it settle a minute, then pour off the water, and the fine will go with it, the coarse having settled to the bottom. Let it stand, until it also falls to the bottom; a short time after, pour off the water, and the sediment is what you want. The barrels are taken out of stain in the same way, as by the other recipes, by hot water; but you must continue to scratch or brush them longer, for by that means you obtain a greater gloss. The principle of this

stain is, simply the hydrogen gas contained in the coal acting on the iron. From being of a softer nature than the steel, which it does not affect, the flame also possessing a quantity of tar, it is imperceptibly embodied by the iron during the action of the oxide, and, when finished, by filling up the spaces created, it becomes decidedly more impervious to damps or wet, than the other stain, which is entirely composed of the oxide of iron.

CHAPTER XXII.

ON THE SHOOTING OF BARRELS.

THE art of making barrels shoot can be acquired, not by understanding the plan of any particular person, but by having a full knowledge of the whole art of gun-making. He that undertakes this, must be master of his art, for it requires greater knowledge and more judgment than any other branch of the business of a gun-maker. This person may promulgate one plan, that person may promulgate another ; but I have no hesitation in saying that such persons are entirely ignorant of the true plan of proceeding. It is impossible to lay down any one particular plan. The plan recommended by each person is, of course, that by which he has succeeded best. It is certainly just as possible to make a barrel shoot by external as by internal alterations, for it is on the external form that the success of the internal alteration depends. It is however a thorough knowledge of the nature of the metal, its hardness, its softness, its elasticity, and its tendency to expansion, that is required. On the injurious tendency or advantages of this latter property in gun-barrels, various opinions exist. That justly esteemed and talented writer Col.

Hawker says, that all barrels should have as much weight of iron, as can be conveniently used, to destroy the expansive tendency. I should like to ask a question or two on this point. I should like to ask him, if the best flint guns he ever saw were not much lighter in the barrel than those of the present day; and whether (he states he killed longer shots formerly) those guns were not much lighter? I should suspect they were, as in all flint guns the barrels were much lighter than at present. If they were so, does not experience demonstrate the impropriety of his advice to increase the weight? If flint-guns, which were only two-thirds the weight of modern guns, shot better, why depart from that standard? I am quite convinced that many of the old barrels, which were bored without any artificial friction, shot much better than any modern gun, bored in the same way. That, it will be said, is owing to the percussion. No: I trust that I have clearly shown that, save on the score of time in exploding, there is no difference. It is owing to the too great increase of metal. It is not the quantity, but the quality of the metal, that will prevent the expansion. An idea got abroad at the time when percussion guns came into general use, that they required a greater strength of iron. This was one reason for increasing the quantity of metal. It was an idea founded in utter ignorance; for the fact is, that at the first lift of the

charge, the explosive force created by percussion is greater than that generated by the flint, but it is only continued half the time; and it is not the actual force, but the time that it is continued that constitutes the real pressure or test. I trust there can be no doubt from the experiments I have already detailed, that a certain quantity of iron, properly wrought and compressed, is equal in strength to near double that quantity not well wrought and compressed. It is, therefore, not the quantity of substance that prevents expansion, but the goodness of the metal, and the closeness of its pores.

The following observations will, I think, enable the reader clearly to comprehend this question. Supposing we take the bore at $\frac{5}{8}$ of an inch, (which I am confident, though it is smaller, is better than the bore now in use;) then if we suppose that the substance of any part of the tube at the breech end is $\frac{3}{16}$ thick of stub-twist iron, and the charge of powder is equal to what will fill an inch in length of that tube, it will be equal in force to 38,921 lbs. Suppose the charge of shot be one ounce in weight, and the friction not greater than a cylinder would give, it is not probable that more than a twentieth part of that pressure comes on the barrel, which would be equal to fifty times that of the atmosphere, or 1384 lbs. Indeed, the probability seems to be in favour of a lower estimate, and even from that we must deduct the pressure of

the atmosphere on the outside of the barrel, which amounts to nearly 50 lbs. The force too diminishes, as the surface on which it has to act increases; or, in other words, as the charge is driven along the barrel. The shot or ball does not receive the full force of the charge at first, but its velocity keeps increasing until it leaves the barrel, which is one reason why long barrels shoot further than short. The reason of the increasing velocity is this:—the velocity generated by the explosion of gunpowder is equal to 7000 feet in a second, when that powder is confined in a tube, without any weight upon it. When having a weight to lift, the velocity will be in proportion to that weight, and the force generated. As the charge is driven onwards, it acquires additional velocity, if there be powder to keep exploding during its progress, as well as to compensate for the loss of force occasioned by the friction. By the foregoing remarks, it will be perceived, that the weight to lift and the degree of friction determine the greater or lesser degree of pressure on the barrel. We must therefore endeavour to discover, whether that friction be calculated to increase the shooting, or diminish, it by increasing the expansion of the barrel.

I have often thought, that expansion would increase the shooting powers of a barrel, but then it must not be the expansion of an unelastic piece of metal, but whose elasticity rebounds

with a force equal to that with which it expands; for whatever else you may obtain by creating a friction, by boring the breech-end of the barrel wider, you obtain a greater expansion, as it no doubt has that tendency. We find it an invariable fact, that when barrels are very heavy compared with their size of bore, (if a cylinder,) they shoot weak. Also, when barrels are made of irons of different temperatures, where one is placed to prevent the expansion or springing nature of the other, they are never found to shoot well. As a proof of this fact, let any one take the best barrel he ever shot with, and encase it with lead very tight; fire it at a dozen sheets of paper, and see if the effect be equal to what it was when the barrel was unencumbered. On the contrary, it will be found to have shot very weak, though close. Let him then examine the lead; and, if of any moderate substance, he will find that the explosion has enlarged it considerably. This experiment I have tried repeatedly, and can vouch for its truth.

The proof of barrels, is another fact in corroboration of the truth of my assertion. What else can occasion the bulging, but the expansion, where the barrels are possessed of soft and hard portions, (which is the result of different tempers or different metals;) one expands further than the other, and then of course, the soft part receives no assistance from the hard, and it does not return to its original state.

Put on a barrel, from the breech-end to the muzzle, a number of rings of lead; be sure you have them tight, and not further asunder than three or four inches; fire that barrel with a usual charge, and if it be a correct taper for shooting, it will have expanded the whole of the rings an equal distance.

I have seen barrels, intended for rifles tried with shot, before they were rifled, and I never saw one that would fire shot even moderately well. From this, I have come to the conclusion, that a barrel is a spring on an extended scale, and the more we can make it partake of the nature of a spring, the better. If we must have expansion, let us have it in its most beneficial form—an expansion that will aid the powder in expelling the lead.

This cannot be entirely obtained, nor can the quantity of expansion be entirely destroyed, though you were to make your barrels of the weight of a twenty-four pounder. We must, therefore decrease it, by making our iron as elastic and as tenacious as possible.

The qualities of elasticity and tenacity can only be obtained by hammer-hardening the iron in the way I have described. Barrels hammer-hardened will nearly shoot as well without any artificial friction, as those whose friction is extreme, yet have not been benefitted by that process. All the old barrels, if their strength was not increased by hammering, it was at least not decreased by

the injurious process of heating for brazing. They were, for the most part, put together with soft solder. The iron, too, used at that time, was of a superior quality, and more elastic; and not like the iron of the present day, partaking more of the nature of lead than any other mineral. This is also the reason that Damascus barrels shoot so well. Their nature is hard, and where they do expand, they contract as quickly. They do not therefore require the friction which a soft barrel does.

I will now show how I ascertained this. I got two barrels for a double gun forged, 2 feet 8 inches long, and 15 bore, from the best stub-iron. I had them completely hammer-hardened in the forging, and I gave them an additional hammering after they were proved; I put them together with tin; breeched them according to my own method; stocked and completed them, except staining. I then ascertained that they were a perfect cylinder, and then fired at thirty sheets of paper, placed at the distance of forty yards. The right-hand barrel put in 74, and the left, 71 shots. The whole were through twenty sheets; 51 right, 54 left barrel were through the whole thirty sheets. This I found to be the average performance. I then bored a little out of the breech-ends for about four inches, with a scarcely perceptible relief. I did the same at the muzzle. I then tried them at the same quantity of paper, and though the closeness was not increased, the

strength was very materially; 59 and 63 being the average number through the whole sheets. Feeling convinced that this could not be beat with No. 5 shot, for general shooting, I determined to come to the gist of the experiment. I therefore took the barrels asunder; heated them red-hot, and allowed them to cool gradually, to be as soft as possible I then re-soldered them together, and polished out the roughness from the heating, with a piece of lead cast on an iron rod, but was careful not in any way to alter the bore. I then proceeded to try them as before, and found that the right barrel put in 66, and the left, 69 shots; through the twelfth sheet, the right 30, the left 32; through the whole thirty sheets, 16 was the quantity each. A pretty satisfactory evidence, I trust, of the injury they had received. Convinced from repeated experiments that they could do no more, I bored them for six inches at the breech and muzzle considerably more than they were, and then could not succeed in making them put in as many as before, nor more than 25 each through the whole sheets; though the friction was now trebled, and the charge full one-half more than before, and the expansion proportionably increased. There can be no doubt then, in this case, from the want of elasticty, the expansion was highly injurious; for the recoil was tremendous. I need scarcely add, when such were the effects, the danger of bursting was increased two-fold. It was a matter of certainty,

that the pressure was full twice, what it ought to have been.

Not being entirely satisfied, I took the barrels asunder again ; and half-way up the right barrel, I put on a piece of lead pipe, by driving it from the muzzle. After securing the barrel in the stock as well as I could, I loaded as in the last case, and fired, when I found that the lead was expanded nearly one eighth of an inch. On trying the left barrel I found it to be about the same.

I then set to work again, and hammer-hardened them, by beating them for nearly a day with small hammers, while the barrels revolved in a groove. I re-bored out the dents occasioned by the hammers, smoothed afresh the outside, and fit on another piece of lead as before. I then loaded and fired, and found that the lead had not been expanded the sixteenth part of an inch; a fact which completely satisfied me of the great advantages of hammer-hardening, and yet the last trial was made with the barrel in the state in which it was bored to make her shoot when soft; and of course the expansion was increased thereby, or probably it would not have been so much. The recoil was dreadful. I then put them together, and tried them again, as they were ; and though they shot very strong, it was very wide indeed. The recoil too was most unpleasant. It was not till I got them near to the original state, that they at all approached their

first performance, and that with the original charge. I also found, that the lead adhered to them more in the soft, than in the hard state; as much indeed, as double the proportion. So that, when we sum up all the various qualities imparted to barrels by hammer-hardening over the other method, they will be as follows:—The power of shooting with less friction, less expansion, and of course, greater safety; an almost total exemption from leading. Any one of these qualities imparted by the practice to a barrel, ought to be a sufficient reason for adopting the plan of hammer-hardening; but when it imparts them all, the reasons in favour of the practice, become so overpoweringly strong, that the prejudice must be obstinate and inveterate indeed, which can resist their force.

From the observations already made, the reader will perceive, that the shooting of all barrels, depend on a certain degree of friction. The degree of friction necessary, varies according to the nature and substance of the metal. Those metals that require least, shoot best. The object of the friction is to create a greater force, by detaining the charge longer in the barrel. If, then, there should not be an extra quantity of powder to consume, the friction would be a decided evil. This may be understood by rifle practice, in which I find, that a short barrel of 18 inches, with a certain charge, will throw a ball as straight, and quite as strong or stronger,

than a barrel of 3 feet, loaded with a similar charge. I account for this fact, thus,—the barrel of 18 inches will burn all the powder put into it; the long one can do no more. As soon as the ball has left the short barrel, it meets with no impediment but the air. By the time the ball in the longer one has travelled 18 inches, the powder is all consumed, and the friction of the remaining 18 inches acts as a destroyer to the force given to it, and it naturally drops its ball short of the other. Increase the charge of powder to as much as the long one can burn, and then it will throw its shot to twice the distance of the other. An addition of powder beyond the quantity the barrel can consume, is disadvantagous—the reverse will be found equally so. Thus it is with fowling-pieces. The quantity of powder that a gun would burn in the shape of a cylinder, would be too little, when, by altering that shape, you increase the friction. The quantity must, therefore, be increased, or this friction will diminish the force of the shot. It is on this, that the mistaken supposition is founded, that short barrels will shoot as far long ones. It is true, that, with a small charge, the short barrel will kill at the distance of thirty yards, as well as the long one; but put in the long one as much powder as it can consume, then try the two at twice the distance, and you will find out the mistake under which you have laboured.

It is on the nature of the metal that the

goodness of the shooting principally depends. That barrel which is possessed of the greatest degree of elasticity and tenacity, will throw her shot strongest and closest, with the least artificial friction. It is on the knowledge of the qualities and temperatures of the various irons, and on practice in the art of shooting, that a man's ability in making guns shoot must rest. All plans are merely methods by which an unscientific maker has most frequently succeeded. It would be no difficult task to produce a hundred barrels which will shoot nearly alike; yet every barrel shall be different in its bore. To a real judge, the thing is as simple as any other process, as he will point out what is required; and it is ten chances to one that he is successful on the very first trial.

The length of friction depends entirely on the length of the barrel. Long barrels require more than short, though the latter require it in a greater degree. A mode of creating friction, much practised by those who are ignorant of the true method, is to bore the barrels as rough and as full of rings as possible. These rings are often taken for flaws; though that may be ascertained by noticing whether or not they have the same inclination as the twist, and whether or not they are at the jointing of a spiral. If they be not, the chance is that they are ring-bored, as they are termed. This roughness, however, answers the same as friction by relief; but barrels thus roughened are very liable to lead,

and become foul. While the well-bored barrel will fire forty shots as well as twenty, these cannot be fired more than twenty times with safety and effect. This is the reason we meet with many guns at the low price of two pounds, or even lower than that, which shoot as well as those that cost fifty pounds.

It is by these means that you may bore barrels to put their whole charge in a man's hat at the distance of forty yards. I have done it repeatedly with guns made to shoot for prizes. Thus made, they have put in from 40 to 45 shot-corns in a circle of 4 inches diameter; a fact well known in this neighbourhood. In truth, I could pick out ten old colliers, in as many miles, who have done it frequently. It is done by creating friction, to an immense degree, from the breech to the muzzle there often being as much difference in the bore as four sizes; or near an eighth of an inch; in short, the barrel is a species of cone from breech to muzzle. When they are loaded, the powder is compressed to a great degree with the ramrod, so that, when ignited, it fires like a sky-rocket, and not much quicker. In fact, the shot goes up to the mark not much faster than a man might run; therefore, when you have obtained friction to a great extent, it requires that the explosive force be decreased, or you endanger your head as the degree of pressure on the interior of the barrel depends entirely on the weight of shot and the friction.

If, then, you want safety and good shooting combined, you must, of course, have that description of barrel best caclulated to give you these desideratums. For this purpose, I give below a table showing the various strengths of barrel made from each description of iron, and the calculated force of a charge of powder and shot of the afore-mentioned quantities. By looking at this table, the sportsman will see at a glance the surplus strength he has to calculate upon.

The following tables will shew the strengths of each iron, and the surplus, after deducting the pressure of the different charges.

	Each iron is equal to the undermentioned number of lbs. to the inch of tube.	The pressure of a charge of one ounce of shot is equal to the underwritten number of lbs. to the inch of tube.	After deducting the pressure from the strength, leaves a surplus of the following number of lbs.
Wire Twist	5019½	1384	3655½
Stub Twist......	4818	1384	3434
Charcoal	4526	1384	3142
3*d*. Skelp	3841	1384	2457
Damascus	3292	1384	1908
Wiswould's	3134	1384	1750
2*d*. Skelp	2840	1384	1456

If the charge be increased to one ounce and a half, the pressure will be full one-half more, as under:—

Wire Twist	5019½	2076	2943½
Stub Twist	4818	2076	2742
Charcoal	4526	2076	2450
3*d*. Skelp	3841	2076	1765
Damascus	3292	2076	1226
Wiswould's	3134	2076	1058
2*d*. Skelp	2840	2076	764

If the charge be two ounces, it will stand thus:—

Wire Twist	5019½	2768	2251½
Stub Twist......	4818	2768	2050
Charcoal	4526	2768	1758
3d. Skelp	3841	2768	1073
Damascus	3292	2768	524
Wiswould's	3134	2768	366
2d. Skelp	2848	2768	72

It will be perceived that when we take the pressure of large charges, the surplus becomes trifling. This computation is taken without calculating the additional friction some barrels have over others; nor does it interfere with the state a gun may be in, from being fired with carelessness, or other causes. Again; if you should by any mistake put in half an ounce more than the highest calculation, the pressure will considerably exceed the strength of the most common irons, and leave but little surplus in even the best.

As these are calculated all one substance, it will be perceived, that the wire-twist is some pounds the strongest; but its faults, which I have pointed out in the description of that iron, more than neutralize the advantage. The stub-twist is next in strength, and had it the addition I have mentioned, would, in my opinion, be quite as strong as the wire-twist. The charcoal is next, and then the skelp. Inferior to these four is the Damascus, in point of strength; but its hardness makes it shoot well, though it is not an iron

on which I should place much dependence. It will not stand much friction; for more barrels made of that iron burst than bulge in proving. Mr. Wiswould's iron comes sixth, in point of strength. Its inferiority is occasioned by the same cause as that which weakens the Damascus iron; it is too much twisted. It does not seem possible to unite in iron beauty of appearance with strength. If the twisting this iron, for the sake of beauty, were dispensed with, and it were wrought only as the stubs are, the grain of the iron running parallel with the spirals, I am confident no iron could possibly exceed it. The remaining description of iron requires no other remark, than that it is the weakest; no one, I should think, who could obtain better, would use a gun made from this iron.

The strength from all these irons, is calculated from the iron in the state in which it comes from the mill, neither improved nor depreciated. It must, therefore, be understood, that if the barrels be brazed at the ends, it will make on the average 12½ per cent difference from the state in which they left the forge; and if they have been hammer-hardened, a further deduction of full 15 per cent; so that the difference on the whole will amount to about 30 per cent. All increase above the weight of the shot here named will increase the pressure in proportion, or rather more; as the greater the quantity the more tube is filled. The impulse having to be communi-

cated from that next to the powder to the other, and that being a non-conducting substance, the pressure on the tube thus materially increased beyond the proportion, a smaller quantity would do, owing to its filling less of the tube.

I shall now sum up, and give my own opinion, as to what should be the length of a barrel. From what I have already said, it will be perceived that I am an advocate for long barrels. I am so, from the conviction that they possess greater shooting powers than short ones. I am also in favour of the abolition of friction, to as great a degree as it possibly can be dispensed with, as it appears to me, that length would much obviate the necessity of friction. For great distances, I would recommend length above all things; as then power or force can be generated to as great a degree as the sportsman likes. The velocity and force of the projectile entirely depend on the quantity of power generated. Should danger be feared, from the increase of powder, decrease the weight of shot as much as you increase the weight of powder, and then the pressure will be the same on the tube as before; for the pressure depends entirely on the weight the powder has to move. If, then, a shooter can use a long gun as well as a short one, friction may be entirely dispensed with; but if he prefer a short one, he will derive from friction, near the same advantages that would be given by length. With the increase of friction, he must calculate

upon an increased recoil, and nothing spoils the shooting powers more. I recollect a few years ago, some individual in London offered a wager of £100, that he would make a gun, which would put more shot-corns through a given quantity of sheets of paper, than any other person could. I would like such a wager just now; only allow me to use a stock and a rest after my own heart, and he will not long brag, without the offer being accepted. As some of my readers would like to know, what sort of a stock I would use, I will tell them, a metalic stock, so heavy, that the recoil could not move it in the slightest degree; and if it did not prove my position correct, I would forswear the trade for ever.

I have now, I trust, explained myself with clearness, and to the satisfaction of my readers, on the principle of constructing barrels so as to shoot. I can add nothing more, except a few remarks on powder, shot, and caps, and what appertains to the rifle, which has always been a favourite with me.

I will, however, give my ideas on shooting, before I proceed to the description of the rifle. All that I shall state on this subject, will be the result of my own observations; as far, therefore, as my statements may differ from those of others, I have only to request, that they may not be rejected on that account, but that they may be examined with candour, and accepted, if consonant to truth.

CHAPTER XXIII.

ON GUNPOWDER.

WITHOUT this ingredient be good, all our preparations and endeavours to obtain good shooting barrels will be fruitless,—our experiments a waste of time. I have always thought, and am quite convinced, that powder is made too small in the grain. For what purpose it is made so, except to please the gun-makers, I never could imagine. I have no hesitation in asserting, that if you obtain powder of fine grain, and powder, composed of the same quality of ingredient, coarser grained, the latter will be found to be stronger than the former. This I have tried in various ways, both by the rifle and the musket, and the same quantity of the coarser invariably gives the longer range. It is owing, in my opinion, to each grain containing within itself greater force. When one is ignited, its effect is greater than that of several small ones. Four times the quantity of small grained has to be ignited, to generate the same force, as is required of the larger grained. Again, the small grain is generally coated with a sort of varnish, which must be injurious to its quickness. Another advantage the larger grain possesses is, that, from its size,

it is less liable to be completely compressed into a solid state, and from the largeness of the interstices around them, more atmospheric air is contained in a body, which must greatly benefit it in igniting, as without question (though it is possible to fire powder in vacuo), it will burn better with the assistance of atmospheric air. The gun-makers say, that the guns would be continually missing fire, if larger grained powder were adopted. This would be no fault of the powder, but theirs. Why not make the chamber wider, up to the immediate vicinity of the point of ignition? Then, at all events, if your theory of the percussion flame penetrating into the charge be right, they cannot miss fire. If you are wrong, I will be bound my improved nipple will do it; but yet there is no occasion whatever for any alteration on that score, as the chamber, both in the breech and the hole in the nipple, can be widened, without making the small hole at the extremity any wider, and neither will it miss fire. But Joe Manton did not recommend that! Thus it is with them in every thing. He would not adopt any thing that was not his own invention; and the trade cannot, because he did not. Verily, you are a precious set! Since poor Joe went to the wall, you have evidently been following him.

CHAPTER XXIV.

ON SHOT.

WITH all our scientific knowledge, we cannot improve the manufacture of this auxiliary in shooting—I beg pardon—it cannot be done without adding to the cost! an excellent reason with many! for it appears that is the truth. There was an immense improvement effected, a few years back, by infusing quicksilver into the lead, and thus making it heavier and more elastic than it was before. There can be no doubt of the advantage of this; yet we do not see it in general use. I can only attribute it to supineness amongst the gun-makers. It is a wonder, too, for it is Joe Manton's invention. There must be some weighty reason! It is dearer; the profits are not so large? No; that is not exactly it! The guns don't lead so much? That is like it. They would not come so often to have it taken out? You have hit it. This composition of minerals would be a great improvement for rifle-balls, as they would penetrate hard substances more effectually; especially the forehead of wild boars, bears, and other animals, which the rifle is required for destroying.

CHAPTER XXV.

ON WADDING.

A GREATER revolution has taken place in this article within a few years than in any other part of shooting. Ten years ago, a piece of playing card was thought sufficient; now we have wadding half an inch thick and even thicker. There can be no doubt that this is a great improvement. In fact, a substantial wadding between the powder and the shot, is equal to a considerable artificial friction in improving the strength, with which the powder expels the shot. It answers the purpose of completely preventing the explosive matter becoming mixed with the shot; and the powder is confined the same as it would be, were there a ball in the barrel that fit tight. Thus the whole force is properly exerted. There is an immense number of different makers of this article at the present time, therefore it would be invidious to name any one. That composed of felt, if sufficiently close in the body, is decidedly the best, and when anointed at the edges with mercurial ointment is calculated to clean the barrel in ramming down; and I may mention (though that has been done) that the lighter that which is on the top is, the better,

if it be strong enough to prevent the shot moving by the recoil, from the barrel.

The patent wadding lately advertised, possesses some merit; but not to the extent the patentee claims. It is, in my opinion, too thin to be efficient between powder and shot. To prevent a mixture of the explosive matter with the shot, there should be a considerable substance. I have before stated that I approved of the wadding known as Wilkinson's Patent Wadding. Were two of these patent waddings, or a similar substance, put on each side of the above-named wadding, but not so thick, and the plate intended to be next the shot a little concave, and the other *vice versa*, I think, with all due deference to Mr. Walker, they would make the gun throw closer and stronger than his waddings are calculated to do, singly. But as they are at present, they are decidedly the best for putting upon the top of the shot; indeed, I think they cannot be excelled, if, as Mr. Walker states, they will prevent the charge from becoming loose. There is one thing I think he has lost sight of, as they are at present constituted—they do not possess that elasticity which is required. They will require the barrels to be bored a perfect cylinder; consequently they will be too small, after being forced down the contracted part. Besides, they must fit the bore to a mathematical nicety, which I think cannot be done, as all barrels, varying from the standard, either a half or even a quarter

of a size, would be fit imperfectly, as he sends them out already cut to the various sizes, and not varying even half a size. Joyce's or Wilkinson's may be used in a barrel a full size less than the wadding is cut, and that without any difficulty. I think it would be difficult to do so with the metallic, but by adopting my plan of making them concave, and inserting a portion of felt between two, and by having these two plates slit or cut on the edges in different places so that they would contract, if necessity required it, they might obviate that difficulty, and at the same time give the sportsman a wadding of superior construction.

CHAPTER XXVI.

ON PATENT CARTRIDGES.

If proof were wanting of the folly of bringing forward any new plan before you have tried it sufficiently in every respect, it would be exemplified by Ely's patent cartridges ; an invention possessing some merit, but the inventor knew not their good qualities, and, I am sorry to say, their defects. And hence the rapidity with which they were damned, to the ruin of a spirited individual. I feel confident at some future period, if the matter be taken up by a practical sportsman, their use may again be revived. For wild fowl shooting, or partridges at the latter end of the season, they cannot be equalled, providing their construction was altered. Instead of wire gauze, I would prefer felt similar to that used in Wilkinson's Concave Wadding, made to contain a moderate charge within them, and fabricated in a similar manner to the first process in the making of hats, but having at the bottom a substance considerably thicker then the sides or parts lying next to the cylinder. I have seen many plans tried, not one of which approached so near perfection as one something similar to this description, giving neither too close a body of shot,

nor too wide, and in no instance balling. There is one point, which must not be lost sight of in using cartridges. If you load with as heavy a charge of powder as in general shooting, their effect is trifling, compared with what it is with a moderate charge. The shot droops considerably more, therefore you must have an increase of elevation, or you will invariably shoot under your object, at any distance above forty yards.

CHAPTER XXVII.

ON COPPER CAPS.

On the goodness of these, I need not tell the reader, much depends, not only on the score of sure firing, but also on the composition possessing caloric or heat sufficient to ignite the powder. Though no chemist, yet I know that there is a great difference in the nature of this article. I also know, that, if pure, it possesses an immense heat; but then the habit of adulterating every thing has become so general, that I feel confident, this article has not escaped. From what I have seen of them, I should think that those manufactured by F. and E. Joyce, are as good as any. There are undoubtedly, excellent caps made in Birmingham; but there the rage for cheapness is carried to such an extent, that if you do not know your maker, you may suffer imposition. (The composition in many of the French caps is good, but the copper is made much too thin, and therefore dangerous.) Many accidents have happened by using these caps on guns, altered by those country gentry, terming themselves gun-makers, but whose proper cognomen is blacksmiths! It is surprising, that many should still continue to have their guns spoiled

by them, and at quite as great a cost, as they would be charged by a professional gun-maker. Some of the first-rate London makers show, in this very article, the spirit that actuates them, as they continue to use caps filled with the old corrosive composition, in spite of any conviction of their evil tendency. They recommend them, too, as the best, though they must be fully assured in their own minds, they are stating an untruth. They may be best for their purpose, no doubt; but this selfishness is unmanly and unfair to talented individuals, who have at great cost and trouble brought to perfection the manufacture of a superior article. Let sportsmen examine the caps they have obtained from these makers, and frequently they will find I am correct in my assertion, that they are corrosive and calculated to injure both the outside of locks and breeches.

The caps on the improved nipple will be found more sure to fire, from the lessening of the part on which the explosion takes place, and a cap containing around the outside of the interior of the cap, where the powder is usually put, a portion of percussion-powder, and in the centre, a composition of gunpowder and spirits of wine; a decided improvement on the score of penetrating further down the nipple into the charge would be effected, owing to a flame from gunpowder retaining its heat longer, though not more intense than a flame from percussion.

CHAPTER XXVIII.

ON GUNS AND SHOOTING.

COLONEL HAWKER says in his work, "You cannot have closeness and strength in shooting combined beyond a certain degree;" an observation in the truth of which, I fully concur; it being found that where there is a greater degree of either strength or closeness, the other requisite is always wanting. Neither would it be adviseable, as the sportsman will find a medium decidedly the best; a medium that will give the shots fairly spread over a space of thirty inches diameter, at forty yards; and so regularly, that a space, which would allow a bird to escape, shall not occur above twice out of five shots, and each shot to penetrate through thirty sheets of paper. It will be found, that a gun doing this regularly, is far superior to one throwing twice as close and not one-half through the paper, as the latter will require four or five pellets to kill a bird, when two of the other would be quite as efficacious, on account of penetrating twice as far.

Having determined on the closeness of shooting, it remains to say a few words on the proper charge, upon which every thing depends. I have repeatedly stated that all guns will burn a

certain quantity of powder; you must, therefore, ascertain, what that quantity is, which can only be done by practice. Suppose you begin with 2 drachms, and vary the charge $\frac{1}{8}$ of a drachm, each shot up to $3\frac{1}{2}$ drachms, or as may be required, according to the length and bore of the gun; and for precison taking three shots with each charge, at a sufficient number of sheets of paper; whichever you find strongest, with the least quantity of powder, that is the best charge; as very likely the two next additions of powder will shoot equally strong, and yet not stronger, because more of it remains unburnt. Therefore the least quantity, that shoots equally strong, is the proper charge, which having once ascertained, never change for any person's plan.

Next, as to the charge of shot. All guns, according to their bore and length, will shoot a certain weight, and a certain size of shot best. A great deal of shot in a small bore lies too far up the barrel, and creates an unnecessary friction; and the shot by the compression at the moment of explosion becomes all shapes, a circumstance which materially affects its flight. If of too great a weight, the powder has not power to drive it with that speed and force required to be efficacious, because the weight is too great in proportion. Those, who reason from mathematical calculation, will object to this doctrine. Say they, the greater the weight the greater the effect. No doubt it is so, if thrown with a proportionate

force; but that cannot be obtained with a small gun. We must adapt the weight of projectile force to the power we are in possession of; and from many experiments, I am inclined to think, that a fourteen guage, two feet eight barrel, should never be loaded with above an ounce and a half of shot, (No. 6 will suit her best) and the utmost powder she will burn. A fifteen guage will not require more than 1¼ ounce; and no doubt No. 7, would be thrown by her quite as strong as No. 6 by the fourteen guage gun, and do as much execution at forty yards with less recoil; and setting aside all other reasons, I should on this account, prefer the fifteen guage-gun, if both be of a length, finding I can do as much execution at the same distance with one as with the other. To render a fourteen guage-barrel superior, I think Colonel Hawker is right in stating, that it should never be under thirty-four inches, which description of barrel I very much approve. With a gun of this length and bore, I have shot pigeons better than some have done with their pigeon-guns, as they term them, fitter for duck-guns. I never met with any, which could kill (even with the charges tripled) with a gun of the above-mentioned size, though they can of course cover twice the space. These guns should be entirely discarded: they are not fit to show the skill in shooting at a single bird. They might do for a shooter in the fens; but should never be tolerated at a trial of skill, which pigeon-shooting certainly is.

All guns, to give a proper velocity to the shot, should be of a length and weight proportioned to the bore; and it may be remarked that you will not find any duck-gun whatever, either sufficiently long or heavy. To be in proportion to the bore; those of a $\frac{7}{8}$ bore should be much heavier, than it is customary to make those of an inch bore. As to the disproportionate articles, called guns, made in London and elsewhere, with a bore too wide for a duck-gun, and length scarcely enough for a blunderbuss, the absurdity and inability of these are too manifest to require any comment; yet people will be found blind and obstinate enough to contend that this sort of gun will kill equal to one much smaller in the bore, and of a proportionate length! In speaking of the longest duck or swivel guns, I may instance Colonel Hawker's account of the performance of these fowling artillery. It appears evident that they do not give anything like the execution, which might be expected from their immense size and capability. The reason of this is obvious. From the great space of the interior to receive that equal pressure on the inch, which a common fowling-piece receives, they should be charged in proportion to the increased size; but then I need not add they would become ungovernable; and in addition to this objection, they could not be forged of malleable iron to be safe, on account of the impossibility of forging a barrel of that weight

by hand hammers, and the little probability of hammers ever being invented to work by steam to do it sufficiently quick. The greater the weight of the barrel, its strength is gradually decreased, owing to the impossibility of sufficiently beating it throughout the whole body. It must be well known to any one versed in mechanics, that an anchor-shank weighing some hundred-weights, is easier broken than iron one-twentieth part of the weight, which has had the advantage of being forged by hammers, where the blows were felt through the whole mass. This cannot be the case in forging large barrels, as the workmen cannot use hammers heavy enough, and consequently the barrel is turned out of hand, with the pores as open as a piece of cast iron. They have tried this with small guns for the artillery service, and it has repeatedly failed, entirely from the want of sufficient power to compress the iron. All guns, therefore, of an unusual size, are not of strength in proportion to a small gun; hence the reason they cannot with safety be charged up to a corresponding scale. Neither are they of the length they should be, if the bore is to be the criterion. It must be remembered that to be charged in proportion, the pressure on the inch should be as many times the pressure on the inch of the small gun, as one is the number of times larger than the other. If we come exactly to the real state of the case, I doubt much,

(when taking into consideration the difference of surface,) that the pressure on the inch in the large gun is equal even to that on a small gun. The comparison might be carried up to the largest artillery, and I doubt whether it would come up to this scale or not; as I well know that the heaviest guns will not throw their projectile as far in proportion as the small gun, because they cannot generate the force required to do it. The same principle is applicable to artillery as to fowling pieces; yet, when they are confined to the size best calculated by the length and bore to throw furthest and strongest, these engineers are not content with this, but wish to throw heavier weights, and in fact they do so, but nevertheless at the sacrifice of both speed and distance; for it is consistent with common sense that if a six pounder will throw her shot 1500 yards with a pound and a half of powder, a twenty-four pounder should throw her shot four times the distance, as she has four times that weight of shot and more than that proportion of powder; yet it is well known, that she will not give four times that distance, indeed rarely twice—a decided proof that the advantage gained is not in proportion.

From the above data, I would say, never make duck-guns above seven-eighths in the bore, if you wish them to kill at a great distance, and not less than fifteen or sixteen pounds weight,

and full four feet long, because then you can generate strength sufficient. Therefore, instead of the large staunchion-guns being one hundred pound weight, they should strictly speaking, be two hundred, and so on. In proof of this I may just mention that, upon repeated experiments, I have ascertained, that a double staunchion-gun, with each barrel of the same bore, weight, and length as a single gun, will kill further than the latter ; simply owing to the advantage of the greater weight of the double gun. I have made observations, when trying moderate-sized and shoulder duck-guns on that fine level piece of sand I have before spoken of, and by tracing the grazing of the shots, I have been enabled to pick them up. The large shot from the duck-gun, mostly No. 2, I have found scarcely 400 yards from the spot where she was fired; the small shot, generally five and six, from a fourteen bore, I have repeatedly picked up at 350 yards; thus shewing that the large gun had not much advantage, but yet making probable many assertions we hear made of killing at seventy, eighty, and sometimes a hundred yards, with a common sized gun. By this it appears possible; for shot that will fly that distance, must kill, if it hit during its flight through the first quarter of such a range; but then, at a single bird, above fifty five or sixty yards, it is always twenty to one against hitting the object at all; as the

pellets begin to separate rapidly at that distance, though their force is still sufficient, and in large flocks is apt to do execution.

Now for a few words on shooting. Shooting flying is not to be entirely obtained by initiation into any particular plan, though laying down the ground work may enable a person to learn sooner than otherwise. Much, nearly all, depends on the judgment of the eye; a mechanical judgment, I may term it, that enables the shooter to say accurately at what rate the bird is flying, and if so, what allowance should be given. I need not tell my readers that birds fly at all speeds, from ten miles an hour to a hundred and fifty. Hence it follows, that there must be a difference between the distance you would fire before the birds flying at the two extremes. A bird flying in an oblique direction will require a different allowance. Again, birds rising and falling, or dropping, a different degree still, and so on. It would, therefore, be only a waste of paper to attempt to give a correct mode. The way I learnt myself was principally by shooting sea-fowl. I had attained considerable perfection with these, before I could kill any of the diving species to a certainty; though I was always confident of being fair on them. At last, by mere chance, I killed, when I was confident I had fired at least a foot and a half short of the bird. I tried the same thing again with the same result, and after that I rarely failed in

killing. The reason is this; if you fire direct at the bird, he is so well protected by feathers and down, that you can scarcely find a gun that will penetrate through them; so that if you do not succeed in putting shots through the head, it is no go—he is off; but when you fire short of him, the shot penetrates a certain depth under the water—this, from its elasticity, turns its direction, and it comes up under his belly, and penetrates him where he has his feathers open, with almost certain success.

I have mentioned this to shew, that it is difficult to kill some birds in a legitimate way; therefore you must resort to schemes of various kinds, according to the size or kind of bird, or the position he is in, else you will never succeed in killing, though, as you would think, quite under favourable circumstances. For instance, some birds in going direct from you, invariably contrive to defend themselves by the rump; others always face you, as if they were aware you could not injure them in that position. I recollect being once on a passage to Leith in a steam-boat; I was not then aware there was such a place as the *Bass Rock*, nor such immense quantities of solan geese in the kingdom of Scotland. I fancied myself quite unprepared for so large a bird, having nothing but No. 5 shot; I therefore never fired, thinking shot so small could do nothing. However, I promised I would remember them in returning. I accordingly

procured in Edinburgh a supply of No. 1 shot. Elated with the idea of taking home a few such prizes, I had all the guns I could muster loaded and ready. We arrived at the spot. The ship's swivel was fired to disturb them, and behold a flock almost sufficient to darken the air, and scarcely more than the height of the mast. I fired ; and fired over and over again without success. The captain had been kind enough to allow the engine to stop, and there they were, flying about and about, every time coming nearer. At last an old sailor, seeing my vexation, called out "load with small shot and fire at the head." In a moment the truth flashed on me. It was done. In about three minutes four were on the water, which by the aid of a dog we got on board. On examining one of them, we actually found some of the large shot wrapped up in the feathers, as large as a marble, which had never penetrated the skin at all, neither was any injury done to the bird by the large shot, except that one of the quills in the wing was shot through.

Thus it will be found that guns have not the power to kill some birds, in the ordinary way ; and also, that every one has something to learn. I can recommend nothing better than practice. I never hesitate to throw away a shot, because the bird flies too quick, or is out of shot. More is learned by killing a chance shot, than by a year's shooting. Let your practice consist of every description of bird, as nothing makes a

good shot sooner than variety. Above all things, endeavour to become a snap shot. It is always superior to that uncouth poking mode of following the birds, and never firing except under a positive certainty of killing. Moreover, endeavour to shoot with as straight and as long a stock as your frame will allow you to use. It increases the shooting strength of the gun, by being so much more firm; and it enables you to avoid shooting under your birds, especially at long distances, which, until the invention of the elevated rib, was, and is even yet, in a measure, the ruin of good shooting; as it matters not how good a line your aim is, the shot drops under the bird; whereas, if you fire too high, there is always a portion of the shot drooping, which will not fail to hit him. A snap-shot, also, when he has attained any perfection, does it so easy, and kills his birds, though he is unconscious that he ever saw the gun.

This is all the advice I can give on shooting, especially when so able a sportsman has gone before me. I shall, therefore conclude, by advising all shooters to obtain, if they can, as good and well-finished guns as our mechanics (and they are undoubtedly able to make the best in the world) can produce, as all real pleasure must be enhanced by a knowledge that you possess as good an article as can be produced. Recollect, however, that though your gun may be perfectly safe, it may, in a moment, cease to

be so by carelessness, or any ridiculous fancy as to the mode of charging. I have stated the truth of the case; and any variation either above or below that, becomes injurious to the gun's shooting, or perhaps to its safety.

A few words more on the inferior description of guns, and I have done. I trust I have said enough to show, that the Birmingham gun-makers (at least a portion of them) are a description of tradesmen that take a pleasure in imposing on any person not qualified to detect the fraud, as inferior an article as they can. Therefore, it follows, that all guns dealt in by hardwaremen, pawnbrokers, and others, are, at a moderate calculation, one-half made from materials thrown aside as wasters; or in other words, damaged or faulty. The reasons are plain; these dealers are generally supplied by men terming themselves general factors, who, in short, deal in any thing from a needle to an anchor. These men take orders for guns, and as they manufacture nothing, they give the orders to any maker, who will make them cheapest. He, of course, with little regard to quality, gets them up with as much profit to himself as possible; and, the responsibility not at all resting with him, he has no compunction in sending them out fitter for the old iron tub, than the hands of a shooter. It is rare indeed, that the hardwareman knows a good one from a bad one; so that he has nothing to fear from his detection.

These articles are, in every instance, sold by the shopkeeper at an increase of more than 100 per cent above the original maker's cost. Thus I have stated, that in which I have a satisfaction, viz., the truth of the case. It remains with the sportsman now to pursue his own course; he may, however, rest assured, such is the fact, let interested persons say what they may.

CHAPTER XXIX.

ON THE RIFLE.

As to the exact period when rifles were invented, we have no correct information. It appears, that a century and a half ago they were in use among the Germans, and it is probable that the merit of the invention belongs to them. They differ from the common gun, by having grooves cut in the barrel, in a spiral direction, throughout its whole length. The object of this spiral is to give the ball, when projected, a rotatory motion on its own axis, by means of which its flight in a horizontal direction is continued much longer than when the ball is projected from a smooth-bored barrel. Hence their superiority.

The mechanical means of cutting these grooves are very simple. On the end of an iron rod, is fixed a cutter, with teeth cut like the teeth of a saw, the shape of the groove wanted On the opposite side of this rod, is a piece of copper, to keep it steady in the barrel. The spiral movement is given to this rod by a socket, through which it works similar to a barrel already rifled, which, together with the barrel, is fixed on a sort of bench from six to nine feet long. Sometimes the rod itself is twisted to the degree of

spiral wanted, and this rod, working through two square holes of its own size, is of course turned while it is passing through. On the end being introduced into either end of the barrel, it is regulated by a screw, raising or depressing the cutter so as to cut less or more; it is then driven with force through the barrel, and re-passed a few times, until it passes easy. The cutter is then made to cut again, by a turn of the screw, and again forced through; repeating the process until the groove is sufficiently deep. The cutter is of course directed by the rod, and the groove is cut with the same degree of turn as that to which the rod is twisted.

The sockets, through which the rod works, are then moved to the next division on the division place, which is placed to regulate the grooves, according to the number wanted in a barrel. The next groove is then cut, and so on until the whole are finished. There exist machines of many forms for the purpose; but all are constructed on one principle, some being more, others less complicated. An iron rod is then introduced into the barrel accompanied by some molten lead, which, when cool, is driven out. This adhering to the jagged end of the rod, is, with the aid of a little flour-emery, forced down the grooves several times, which not only removes any trifling obstruction, but gives to the whole a much finer polish.

As there exist difficulties in getting these steel

rods correctly twisted, I would prefer the directing socket, or the more complicated machine, as less likely to be imperfect. If the rods were drawn through a hole in a die or dies, having the necessary twist, in the same manner that wire is drawn, they might be obtained very perfect. However, so great a secret is made of this most simple operation, that it is almost impossible to obtain a sight of either one process or the other.

The point, however, which I shall endeavour to elucidate, is the correct degree of spiral which barrels of different lengths require. I have repeatedly tried barrels with spirals varying from one turn in $4\frac{1}{2}$ feet down to a turn in $2\frac{1}{2}$ feet; and the conclusion I have come to is, that a barrel 3 feet long should have $\frac{3}{4}$ turn in its own length, being one turn in four feet; a barrel 2 feet 6 inches, as much in proportion as a turn in 3 feet 6 inches; a barrel 2 feet and under, a full turn in the space of from 3 feet to 2 feet 6 inches, according as they vary in extremes; a short barrel requiring much more twist than a long one. The form of groove should be a half-round, and the number according to the size of the bore; but they should be so close as to make the projection approach to an edge or surface, varying from an eighth to a sixteenth or less of an inch, which will of course vary with the number and the breadth of the grooves. A barrel carrying a ball, eighteen to the pound, I would have with either eleven or thirteen grooves.

Those made for the British Government, I believe have only seven. The Germans have their rifles with as much as one turn in three feet, and even more; but their barrels are generally short. The Americans have quite as much twist; but their barrels are very long. As either the German or the American rifle must be constructed on a wrong principle, I shall endeavour to discover which.

It is an ascertained fact, with respect to gunpowder, that a certain quantity only can be burnt in a certain space. This being the fact, it follows, that the short rifle cannot project a ball beyond a certain distance, as within a barrel of that length, more than a certain degree of power cannot be generated. The velocity, too, of the ball being determined by the degree of force, it cannot obtain above a certain speed. This speed progressively increases as it travels from the breech to the muzzle. If it follow the spiral of the grooves, and revolve with them until it leaves the muzzle, it will continue to revolve to the end of its flight. It must, therefore, be clear from this establishment of facts, that a long rifle, charged according to its length, must, of course, generate more force, and give the ball a greater initial velocity, than would allow it to follow the grooves in a barrel with much spiral. For instance, by the time the ball has travelled eighteen inches, it has acquired that degree of velocity with which the ball projected from the

short rifle left the muzzle. Its speed and force still keep increasing as it travels the remaining length of the longer rifle; and that force and speed become so great, that it is liable to overtop the grooves, if the spiral is of the same degree as in the short one. I account for it thus; the speed of the projectile is increased every inch it travels in the barrel, after the first movement, if the force be proportionate. If the speed it has acquired by the time it has travelled the distance of eighteen inches, be at the rate of 1000 feet in a second, it will have acquired twice that speed, when it has travelled the other eighteen inches. With a velocity so increased, it is not probable that it will follow the grooves, but that it will overtop them. To prevent this, a barrel should be very much twisted in the spiral at the breech, and that twist should keep decreasing towards the muzzle. We will suppose a barrel three feet long with a full turn in the spiral. For every hundred yards this barrel projects a ball, it causes it to revolve on its own centre 100 times. Thus, the outside of the sphere has trebled the distance of its centre, and has naturally that addition of atmospheric air to contend with. I would ask, if this ball can fly with the same velocity as a ball that revolves only fifty times? Assuredly it cannot.

The ball will not pay that attention to the grooves, except the barrel is very short, and

then the speed is less. This I ascertained after repeated experiments with an American rifle and a German one, the former 34, the latter 32 balls to the pound. The American was three feet two inches long, the German twenty inches, and the turn of the spiral in each, in proportion, once in three feet. The first experiment was at a body of soft clay, at 100 yards distance. The charge of powder in each was alike. I found both the balls, and on examining the ends, found that one furthest in that had been projected from the barrel first, and the marks cut by the grooves on the edges of the ball quite perfect. I then increased the powder and fired again. On examining the balls, I found the long rifle had obliterated all the marks made by the grooves on the ball. It would go down the barrel without any pressure, and had the appearance of an oblong, occasioned no doubt by its coming straight out of the barrel, and not following the inclination of the grooves. The appearance of the ball thrown from the short rifle was the same as before. I then cast a length of lead in the long rifle barrel and cut it into pieces like balls, and loaded with the small charge of powder and one of these pieces of lead. I fired, got the piece of lead, and found the projections cast on it by the grooves in the barrel nearly as perfect as when put in. I then loaded her again, with the increased charge of powder, and another of these

pieces. I fired; and found, on searching for the ball, that it had gone in broadside. The projections were clean cut off.

I then tried these two rifles, as to range, and found that, with the same charge, the range averaged within thirty yards of each other. The long rifle had the advantage. The situation being the same on which the former experiments were tried, the balls were easily obtained by tracing their grates, until they were spent. With the small charge, the projections were perfect. On increasing the charge, I found that the short rifle did not increase her range above twenty yards, while the range of the other was increased nearly 120 yards; but then, as I expected, the projections were cut quite off. These experiments, I trust, prove the correctness of my assertion, that in a given space only a certain degree of force can be generated, and that if the charge be small, or the velocity little, the ball will follow the spiral of the grooves; but then, when the charge is proportioned to the greater length, too much spiral is an evil, by creating friction, and thus unnecessarily destroying the force and velocity, and neutralizing the effect intended to be given by the spiral movement.

I then altered both to percussion, in order to ascertain the difference. On firing with the small charge, as before, I found the range some yards greater in both. On examining the balls, they both looked as if the projections had been

partially cut. I have no doubt that this had been occasioned by the increased speed. I then added about one-half of the increased charge of powder before used; and, on firing, found that the ball from the long gun had its projections cut off, certainly, but not so close as before; while that from the small gun was without alteration. From this and other experiments, I concluded that for rifle-guns, percussion is very much superior to flint, and will, for military purposes, be adopted sooner or later. I have also come to the conclusion that, in a percussion-rifle, the term of the spiral should be less than in a flint one, on account of the increased velocity given to the ball.

A great many double-barrel rifles have been made of late years. I very much approve of them, and, if put together perfectly parallel, they are calculated to shoot quite as correctly as single ones; but several that I have seen have a considerable inclination, or convergence, at the muzzle. The individuals who manufacture these can know nothing of correct shooting, or they would be aware that there should be no recoil in a rifle gun, therefore no allowance for swerving outwards, nor, in fact for any thing save the thickness of the side of the barrel; and that, in a hundred yards, would be too minute to be settled by the eye. One great advantage of a double rifle, independent of possessing two shots instead of one, is, that the other barrel assists effec-

tually in destroying any recoil that may arise. To obtain this desideratum, the Americans, the Swiss, and most other nations celebrated for the use of the rifle, make them very heavy in the barrel. Indeed the Swiss sometimes, for mark-shooting, have them 40 lbs. weight in the barrel alone; but then a rest is generally used; and for their precision in hitting the mark they aim at, they are, up to the present day, unrivalled.

Military rifles should never be shorter than 3 feet,—say 3 feet 3 inches,—the length of the musket. They should not be larger in the bore than a ball eighteen to the pound, as at that length a force, calculated to throw an extreme distance, might be generated. Whatever may be the arguments for heavy substances, they do not avail here, as it is impossible to throw them either with velocity or accuracy; for there never can be certainty where so much elevation is required. The size of ball I have mentioned, can be thrown with great certainty, as far, if not farther, than any soldier in his Majesty's service can accurately survey a single object. For the purpose of annoying a dense body of men, such as a square column, such a rifle would be an invaluable gun; as no musket ever yet made will throw a ball one-half the distance. As to the actual range of a rifle of this bore and length, I should think it would reach, effectively, the dis-

tance of 500 yards at an elevation; as, however, a ball in its flight describes a parabolic curve, so great an advantage cannot be obtained by the elevation of the rifle, as of a smooth bored gun. For mark-shooting, at short distances, with small charges, they of necessity require elevation, as accuracy and not force is then the object; and as the ball flies slowly, elevation to a certain degree is indispensable to obtain accuracy.

As many opinions exist as to the exact distance for what is termed *point blank* (and this the gun-maker may arrange, either by increase of powder, or by altering the elevation) it may be expedient to come to some determination. Before it is sighted, a rifle should be tried, and the quantity of powder it will burn ascertained: then, to whatever distance she will project a ball in a parallel line with the earth, (if a plain,) is the *point blank* distance. The distance the ball droops in the next fifty yards should be ascertained, and a corresponding elevation added to the breech. As the best mode of sighting a rifle is by the leaf sight, the lowest sight should be made at this elevation. The next fifty yards must also be obtained in the same manner; and so on, till you obtain the extreme distance to which the ball is sent.

Moreover, as the shooting of all guns depends on the force given, a determination should be come to, when the rifle leaves the gun-maker's

hands, as to what charge should be used. For if the charge be altered, the elevation must also be altered.

Hair-Triggers are an invaluable addition to a rifle; but, I fear, that they would, in the hands of many a private soldier, be a dangerous article; for so careless is the manner in which many of them handle their guns, they might easily shoot their comrade. They had better, therefore, (as far as regards military purposes) be dispensed with.

A word to the Americans. They, I believe, are just now dissatisfied with the rifle. They assert that a smooth bored gun will shoot stronger. It is quite possible, if they continue to use their rifles with so much spiral, and to load with so small a quantity of powder; for if the friction be increased, the power must also be increased, or you decrease your distance, as nothing destroys power more than friction. They should be much less twisted in the spiral, if they still continue in considering, as I myself do, a long rifle better than a short one, for generating force, and for the superior accuracy, with which the person using it can shoot by the sight. A variation of the long rifle, in the smallest degree, is not one-half so much when multiplied, as the variation of a rifle shorter by one-half would be.

The English military rifles are much too short, both for obtaining great range of distance, and

for accuracy of aim. Force cannot be obtained without length. I cannot see, if our rifles were made with the barrels a little tapered, that it would be at all objectionable; as it would allow of a greater length without any additional weight, and, by judicious management, they might always be less than those of the musket.

The principal objection urged against the adoption of the rifle, is that of loading. I know not how quick it is possible to load a musket; but with cartridges properly made, I think I could load and fire a rifle four times in a minute. But then it will be said, at the conclusion of so many shots, the rifle gets so foul, that it will be difficult to get the ball down. No difficulty at all. Have your cartridges made with one of Joyce's patent waddings; or, if you like it better, one of Walker's metallic, made to fit the grooves of the rifle, to precede the ball.

It would clean the barrel so much, as to allow 40 shots to be fired with as much ease as you now fire twenty. Or let a steel-wire brush be attached to the rifle; and by screwing it to the end of the rod, you can, by two or three times rubbing up and down, remove any accumulation of dirt from the powder. If, however, the wadding I have mentioned were used with a weighty rod to the rifle, there would be no occasion for clearing short of 50 shots.

I shall now close my remarks, having, I trust, shewn in a few words the principle of rifles.

As predictions have before been made on this description of gun, I shall avoid them, merely suggesting to those connected with military arrangements, that it would be proper, if any alteration be intended, to offer a handsome premium either for the best treatise on the rifle, or the best constructed one for their purposes. I will be bound a greater improvement would thus be effected, than any yet made. I do not depart from truth when I say, that the rifle is as yet but little understood by military men, or they would never have used a short one for military purposes. But it is generally thus. The opinion of those who best understand the subject is never asked.

CHAPTER XXX.

ON THE MUSKET AND OTHER MILITARY FIRE-ARMS.

I SHALL commence this subject by an extract from a valuable work published in Birmingham, by the authority of the Proof Company; as I find the description of the various kinds is as perfect I possibly could make it.

They say, "we now proceed to give a more particular description of the fire-arms used by the British forces, both by infantry and cavalry; as well as of those used in the same services by the French. We have before stated, that the muskets formerly used by our infantry was of a much more heavy and clumsy description, than those now in use; this musket, called the Old English Musket, was used till about the year 1794; it was of the following dimensions:—

Length of the Barrel in inches	42,
Diameter of the bore	,75
Diameter of the ball for service	,676
Weight of the ball for service, in ounces avoirdupois	1,06
Weight of the musket with bayonet, in pounds avoirdupois	15,

"This musket being found inconvenient to the soldier, from its unnecessary weight, the Board

of Ordnance about 1794, adopted the pattern musket in use by the East India Company's forces: this musket being of the same calibre as the preceding one, and not having the weight of the old one, was found to be more serviceable, and was used by the British armies during the late wars. It is of the following dimensions:—

Length of the barrel in inches	39,
Diameter of the bore	,75
Diameter of the ball for service	,676
Weight of the ball for service, in ounces avoirdupois, ...	1,06
Weight of the firelock with bayonet, in pounds avoirdupois	11,91

"We have before stated, that the Board of Ordnance, about the year 1808, adopted two new pattern muskets, and of which a few were made during the following years of the war, both by the gun-makers in Birmingham and at the royal manufactory. After the peace of 1814, the Ordnance Department entered into arrangements with the individuals engaged in the-gun trade in Birmingham, for a further supply of these muskets, to be delivered in certain proportions during the three following years (the numbers we have before stated.) These are called the new pattern land musket and the light artillery musket. The length of the barrel of the former is 42 inches, that of the latter 39 inches. The calibre of each of these is the same as that of the India pattern musket. The light infantry musket has a back sight, similar to those upon the rifle-gun,

soldered upon the barrel about three inches from the breech-end, and the barrel is four ounces lighter than those of the India pattern. Since the peace, the British forces have been supplied with these muskets. The light infantry regiments with the latter, and the rest of the infantry with the former.

"The serjeants of the British light infantry regiments carry, instead of the pike or halbert, a small musket, of the following dimensions:—

Length of the barrel in inches....................	37,
Diameter of the bore in inches	,65
Weight of the firelock with bayonet, in pounds avoirdupois	9,

"In the British cavalry there are several regiments who are armed with rifle guns, in addition to which piece, they likewise bear a sword, which can, when necessary, be fixed to the piece by means of an iron bar soldered upon the muzzle. There are seven cuts in the rifling of the barrel which make from the breech to the muzzle about three quarters of a turn. The rifling of these fire-arms is done with particular care, and when rifled, they are tried by forcing a ball considerably larger than the calibre through the barrel, which cuts in the ball the form of the rifle, and this ball must then pass freely through every cut of the rifle before it is marked as perfect by the inspector. In the butt of the piece there is a cavity cut in the stock, for the purpose of holding the balls, the leather in which they are wrapped,

and other apparatus, and which is covered with a brass plate, which fastens by means of a spring catch. The dimensions of this piece are as under:—

Length of the barrel in inches	30,
Diameter of the bore in inches	,623
Weight of the ball for service in ounces	,761
Weight of the piece with sword, in pounds avoirdupois	10,75

"The fire-arms used by the British cavalry are the carbine and pistol, and are of several patterns; those carried by the household troops are wider in the calibre and much heavier than the arms used by the other regiments of dragoons, whilst these again are different to those of the light cavalry troops, being heavier and longer in the piece; the carbine of the household troops, and of the other regiments of heavy cavalry, have a bayonet, which is fastened to the muzzle of the piece in a similar manner to that of the musket. The carbine and pistol carried by the household troops are of the following dimensions:—

CARBINE.

Length of the barrel in inches	26,
Diameter of the bore	,75
Diameter of the ball for service	,676
Weight of the ball for service in ounces	1,06
Weight of the carbine and bayonet in pounds	9,5

PISTOL.

Length of the barrel in inches	9,
Diameter of the bore	,75
Diameter of the ball for service	,676
Weight of the ball for service in ounces	1,06
Weight of the pistol in pounds	3,

"The dimensions of the carbine and pistol borne by the heavy regiments of cavalry are as under:—

CARBINE.

Length of the barrel in inches....................	28,
Diameter of the bore	,645
Diameter of the ball for service	,623
Weight of the ball for service in ounces	,8
Weight of the piece with the bayonet in pounds	8,25

PISTOL.

Length of the barrel in inches....................	9,
Diameter of the bore	,645
Diameter of the ball	,623
Weight of the ball	,8
Weight of the pistol................................	3,2

"The carbine carried by the light regiments is as we before observed, shorter than the carbine used by the heavy cavalry; the barrel of this carbine is only sixteen inches in length. From the nature of the service of this description of our forces, in making rapid charges, and generally using more activity than that of the heavier description of our cavalry; it was found that considerable inconvenience was occasioned by the ramrods of the piece becoming loose and falling out of them, to which they were the more liable in consequence of their shortness. To remedy this inconvenience, about the year 1806, a mode was adopted by means of a swivel, which is fastened to the muzzle of the piece by means of an iron stud soldered to the under side of the barrel close to the end; through this swivel the rod passes, and after the rod is passed through it, the head of the rod is screwed on, and which

being larger than the hole in the swivel, prevents it falling out. This plan was invented by Lord Paget, now Marquis of Anglesea; at least the piece is called the Paget Carbine. The pistol has likewise the swivel in the same manner as the carbine. These arms are of the following dimensions:—

CARBINE.

Length of the barrel in inches....................	16,
Diameter of the bore	,645
Diameter and weight of the ball, the same as the last described	
Weight of the piece in pounds....................	6,

PISTOL.

Length of the barrel in inches....................	9,
Diameter of the bore	,645
Weight, &c. the same as the last.	

"In the British naval service, in addition to the musket carried by the marines on board our vessels of war, and which is the same as that used by our land forces, a portion of the seamen are occasionally armed with pistols, which, together with a cutlass, they carry when employed in boarding enemies' vessels, or in instances, certainly not of frequent occurrence, in repelling boarders attacking our own. This pistol is of the following dimensions:—

Length of the barrel in inches....................	12,
Diameter of the bore	,556
Weight of the piece in pounds avoirdupois......	4,

"From the preceding account of the fire-arms used by the British land and naval forces, it will

be observed, that they are of several different calibres, a circumstance which has on some occasions been attended with serious inconvenience, owing to mistakes having been made in supplying from our magazines cartridges not adapted to the several descriptions of arms; as for instance, musket cartridges which some of our cavalry use, have been sent to other bodies of cavalry, whose arms were too narrow in the bore to use them. This anomaly does not, we believe, exist in the military fire-arms of any other European nation. In the fire-arms used by French forces we know it does not, but the musket, the carbine and pistol, are of one, or nearly of one calibre, so that one description of cartridge is supplied to all their forces. It is believed, that the Ordnance Department have had it in contemplation for some time past, to alter the model of our military fire-arms, and to make the whole of them of one bore. If this were done, it certainly would obviate in future any inconvenience which might arise on this head. Perhaps the principal obstacle against the adoption of it, is, the very large supply of arms of the old pattern at present in our arsenals.

"We shall now give a description of the fire-arms used in the French service; they are in many respects very different from the British, and in nothing more so than their outward appearance. The barrels of the French musket are not fastened in the stock like the British

musket, by means of studs soldered upon the barrel, and a wire passing through the stock and and the stud; but are fastened by means of clips or bands, which are made to go over the barrel and stock in different parts of it, from the breech of the barrel to the muzzle, at intervals of about eight inches apart, and which bind the barrel to the stock with a tolerable degree of firmness; these bands give to the French musket an appearance of clumsiness, and add considerably to its weight. The French musket, fitted up as it now is, by means of bands, is nearly one pound lighter than the British musket; and if it were fitted up in the same manner as ours are, it would be nearly two pounds—an object of considerable importance to the soldier.

"The barrel of the French musket is longer than the British, and the bayonet is shorter, though not so much so as Mons. Dupin states, as to make the barrel and bayonet of the British musket equal in length to the French, as will be best seen by the following table:—

FRENCH MUSKET.

Length of the Barrel in inches	44,72	
Length of the Bayonet in inches	15,	
		——59,72

BRITISH MUSKET.

Length of the Barrel in inches	39,	
Length of the Bayonet in inches	16,	
		——55
Difference of Length in favour of the French Musket		4,72 inches.

"In the comparison just drawn between the respective lengths of the British and the French muskets, that of the British is of the India pattern musket, which was used by our forces during the late war; the musket now carried by our infantry is longer, the barrel being 42 inches and the bayonet 17 inches, being very nearly equal in length to the French musket.

"The locks of the French musket have a brass pan, and are altogether heavier, and have a more clumsy appearance than the British. The calibre of the barrel is likewise narrower than ours. This will be more distinctly seen by the following statement of the dimensions of the French musket, and of the new pattern musket now carried by the British forces:—

FRENCH MUSKET.

Length of the barrel in inches	44,72
Diameter of the bore	,69
Diameter of the ball for service	,65
Weight of the ball for service in ounces avoirdupois	,958
Weight of the firelock with bayonet, in pounds avoirdupois	10,98
Length of the barrel and bayonet in inches	59,72

NEW LAND PATTERN BRITISH MUSKET.

Length of the barrel in inches	42,
Diameter of the bore	,75
Diameter of the ball for service	,676
Weight of the ball for service, in ounces avoirdupois	1,06
Weight of the firelock with bayonet, in pounds avoirdupois	12,25
Length of the barrel and bayonet in inches	59,

"The carbine and pistol carried by the French

cavalry are, as we before stated, of nearly the same calibre as that of the musket; and the barrels of both the carbine and the pistol are fixed in the stock by means of clips in the same way. The barrel of the carbine is longer than any of the British, and that of the pistol is shorter, as will be seen by the following statement:—

FRENCH CARBINE.

Length of the barrel in inches	29,83
Diameter of the bore	,676
Diameter of the ball for service	,65

FRENCH PISTOL.

Length of the barrel in inches	7,9
Diameter of the bore	,676
Diameter of the ball for service	,65

"It is not our intention to go into any detail of the improvements which have been made within these few years in the construction of the locks of fire-arms, by means of the percussion action instead of the flint. Still, however, we may be permitted to say, from the simplicity of the action, and the sureness of giving fire, as well as the less trouble it will give the soldier in charging his piece, together with the consideration that the percussion may be made as cheap as the flint lock, that in a few years we have no doubt the principle will be taken up by our government, that all fire-arms for military purposes, will be made upon the percussion principle, and that, like the old match lock, so the present flint lock will in a few years become obsolete."

The English musket has been held up, by military writers, as the most perfect of any in use in Europe. Mons. Dupin, a French military writer, in describing the English forces, says, "the British musket is remarkable on many accounts; we shall, therefore, make it the subject of particular inquiry. The calibre of the English musket is larger than that of the French; and, as the piece itself is shorter, it is not much more weighty. The calibre of this arm being thus superior, and equal to ours in other respects, it carries further, notwithstanding that its length is less than that of the French fire-lock. The shooting of the barrel will doubtless lessen the initial velocity of the projectile, but as the projectile is of larger volume, it loses its velocity much less rapidly.

"It preserves for a longer time, and to a much greater distance, sufficient force to inflict dangerous wounds. Another advantage in short fire-locks, is, that they fatigue the soldier much less, while holding them in a horizontal position, either to fire or charge bayonets." Colonel Napier says in his history of the Peninsular War, "It is well known, whether from the peculiarity of our muskets, the physical strength and coolness of our men, or both combined, that the fire of an English line, is, at all times, the most destructive known." Though I am not a military man, but a practical gun-maker, possessing no prejudice, yet I cannot avoid say-

ing, that to me, none of the conclusions of Mons. Dupin seem correct.

His own words prove one point at least. He admits that the shortening of the barrel will decrease the initial velocity of the projectile. How then can it be projected to a much greater distance? The assertion contradicts a principle on all hands admitted, that decreased velocity requires an increased elevation, to give an equal range of the latter to the former.

The intention of musketry is, that the gun shall throw the ball to a certain distance, in a horizontal direction, so that the height ofthe ball shall never exceed a certain distance from the earth; for instance, the height of a dragoon on on horseback. If, then, in one description of gun, it requires elevation to obtain the same range that another would give without any such elevation, must not the latter be preferable to the former, notwithstanding the advantage likely to be derived from the projectile never rising above a certain height from the earth, which must frequently be the case where elevation is used? I never saw French practice; but if we take the bore of their musket as a criterion, it is calculated to throw further than ours. It is, ,69 of an inch diameter, while the English is ,75. For this reason, the French musket is undoubtedly capable of generating a much greater force, in proportion to the weight of the ball, than the English. I trust I have fully

shown, in the course of this work, that the force generated, and the weight to lift, must be taken into consideration, in computing the initial velocity of any projectile. The weight to lift, in the English musket, is too large for the force generated. As an illustration, the distance to to which the balls, in military ball practice, are thrown, judging from my own observation, does not, on an average, exceed 110 yards. This assertion will probably create a little wonder among those who have not paid any attention to the subject.

It is, however, a fact. I do not exactly recollect, nor have I the means of ascertaining, but I think it is COLONEL NAPIER, who says, (speaking of some of the principal engagements during the late wars) that, according to his computation, not above one out of every 300 balls expended, took effect. From what does this arise, but a deficiency in the musket, the mode of charging, or a want of skill in the soldier? It may be said, that battles are sufficiently destructive of human life, would you like it more so? War is undoubtedly a necessary evil, and cannot be avoided; therefore, the shorter its continuance the better—the more destructive the engines, the better—the less a war costs a nation, the better. Would it not be better that the taking of the life of an enemy should not amount to 75 shillings for powder and ball alone, independent of other expenses? But to the musket; I should think

this acknowledged inefficiency is to be attributed to its construction and the mode of charging. The bore of the musket is unquestionably too large, the mode of charging more deficient still. The soldier, as all men would do, who know as little of the principles of gunnery as the average of British soldiers do, takes as direct an aim as he can. He never thinks, nor has he ever been taught, to give any elevation or shoot high at the object in view, if at a good distance, consequently the ball comes to the ground short of that object; and should it rise again, it is so deflected from its line, as, in twenty cases out of twenty-one, to be useless. I have tried some of the best muskets I could obtain; and have invariably found that, when fired perfectly horizontal, and on a plane, supported by a rest, at the height of five feet, the average distance at which the ball came to the ground, was under 130 yards. This may be attributed to more causes than one; the principal is the great degree of windage allowed. The diameter of the ball, used in the English musket, is ,676, while the bore of the barrel is as much as ,75. The weight of the ball is 1,06 ounces avoirdupois; thus leaving a large portion of the bore for windage alone.

I am not exactly aware for what this is intended; but it is a practice which destroys the efficiency of the gun to a very great extent. It occasions, too, a great waste of powder for no apparent benefit. From an experiment I lately

tried, I found, that with a ball ,75 in diameter, which filled the bore completely, the service charge of powder gave a range of the average of 200 yards, fired horizontally as before, and that, too, with all the additional weight between a diameter of ,676 and ,75.

The service cartridge contains six drachms of powder, and, with the windage allowed, it will be within the truth if we say, full $\frac{1}{4}$ of that escapes, which is a clear loss of $1\frac{1}{2}$ drachms of powder each shot, besides the injury which it must cause to the ball in keeping a direct line of flight, and the impediment that ball will also meet with by the explosive matter retarding it, after having escaped past it. That it does so escape, there can be no doubt; for four drachms will give a greater range, where the windage is cut off, by using a larger ball, than the six drachms in this instance. It is also calculated to injure its line of flight in another way. On which ever side of the cylinder the explosive matter is in the greatest force, the ball, from its looseness, will be driven to the opposite side, and will rebound and return again to the opposite side, and thus obtain a sort of zig-zag course, which, no doubt, it will retain to the end of its flight, and which must naturally retard it, owing to its diminished velocity and the action of the atmosphere on any body performing this sort of crooked flight, tending to bring it sooner to the earth, than where the direction is more in

a line. The idea that a heavy ball is more advantageous, is correct, as far as mathematical calculations go, and, therefore, is correct according to scientific reasoning; but, then, mathematical rules do not always accord with practice. Of the truth of this remark musket practice forms an illustration. They adopt, as the most perfect, a bore of ,75 and a ball of 1,06 oz. weight. To impel this ball a charge of 6 drachms of powder is required; and the greatest distance, to which this immense quantity of explosive matter will project this ball, before its grazing the earth, is 130 yards. Now I have seen a ball only 18 to the pound, or ,645 in diameter, or ,88 in ounces avoirdupois, thrown by only 3 drachms of powder (half a musket charge), on an average, 250 yards, before grazing. But then, say the mathematicians, it being so much lighter it would not penetrate so far in. At 200 yards I have seen a ball that size go clean through a two-inch oak plank, and fly fifty yards afterwards. I have seen it done with a rifle, at 300 yards. It is possible a musket might do so, but after the elevation she would require to project it that distance, it would be twenty to one against hitting such an object, and then she would require all the assistance weight could give her, to go through it. Velocity is quite as necessary as weight in penetrating or passing through hard bodies. For instance, fire a gun with a small charge of powder and ball at a square of glass,

and the ball will shiver the glass into a thousand pieces. Load with more powder to give a greater velocity, and try the same again at another piece of glass, and it will pass through a hole scarcely its own size, and that, too, without in any way injuring the remainder of the glass. This, I am aware, is considered an advantage in naval artillery, but that it should be so in musketry cannot admit of a thought, as you do not wish to shiver the body of an enemy, being content with killing him.

From many trials I have made, both on the score of velocity and weight of projectile, I find that without both are combined to a certain extent, neither is sufficiently efficient. I have fired at a body of sheet iron, $\frac{1}{4}$ of an inch thick up to $\frac{3}{8}$ of an inch, and with great velocity the balls would pass clean through; diminish that velocity, and they would bulge it in the opposite side near to bursting; decreasing that velocity still more, they would just leave a dimple, and so on. The musket at from 25 to 30 yards would put the ball through; at 35, scarcely; at 40, not at all. At 50 yards with a rifle, eighteen to the pound, I have put them clean through, and gone 80 yards before grazing. Therefore I should say, it is not weight alone, but velocity and weight combined that render a shot effective. I have tried rifles and smooth bores, varying from 10 to 100 to the pound, (what is termed pea-rifles from the resemblance

the ball bears to a pea,) and I never could perceive any material difference existing in favour of the heavy over the light, in regard to distance of range. At a point blank or horizontal direction, the smaller invariably threw her ball a greater distance before grazing, and even at small elevations she retained the advantage. It was not until the elevation became great that the heavy balls obtained even a trifling advantage, and then, the greater difficulty of hitting with such an elevation more than counterbalances any advantage, arising from the greater weight of projectile, or the trifling additional distance in range. When, however, I came to try the 18 to the pound rifle against the 10 to the pound, the advantage was glaringly apparent in favour of the former. She gave as great a range with less elevation, which I solely attribute to the greater velocity with which the ball was impelled. This applies equally to smooth-bored guns as to rifles. You cannot throw more than a certain weight a certain distance, with the means you at present possess. If men were on the average 6 feet 6 inches in height, and 18 stone weight, instead of 11 or 12, the musket a full foot longer in the barrel, the ball of a size to fit the bore, and the musket itself increased in weight in proportion, you might succeed in projecting balls of that weight the distance a lesser ball can be projected at the present time; but until then you must remain content with the musket as it

is, if you are determined not to adopt a kind of gun in which the means of generating force, is equal to the weight to be projected, and the distance of such projection.

That they are not so I am convinced. For were the balls made to fit the bore, or without any windage at all, the recoil to the soldier at any event would not be advantageous; he, I believe feels it enough at present. Another reason advanced why large balls are preferable to small is, that in shooting in any direction where the wind blows across, the small ball is apt to be deflected from its line of flight. This I admit to a certain extent; but as such a circumstance occurs but occasionally, I would ask, which is of most consequence, an occasional allowance for such a deflection, or an elevation which must always be given, as well as sometimes an allowance the same as for the former, though not to as great an extent? for at any event the chances for the necessity of such an allowance are equal. I should imagine it to be a desideratum in military tactics to reduce every thing connected with them to as near simplicity as possible.

The English soldiers, or at least many of them, are men who never fired a gun in their lives, until they enlisted; they consequently know little of the management of a gun. When they come to fire ball, they, as directed, fire in as good a line as they can. The meaning of elevation is

unknown to them, and in nine cases out of ten, the ball never reaches the distance the target is placed at.

I remember, a few years ago, a yeomanry corps was embodied in the town I was in. At the conclusion of their permanent duty, a silver medal was given by the officers, to be shot for by the dismounted troops, who were armed with a sort of carbine similar to the serjeants' carbines of the present day. The target was fixed at eighty yards, and at the conclusion of the shooting, out of 400 cartridges, which had been fired, not 350 balls passed the target until after they had struck the ground short of it. In fact, the prize was won by a soldier, whose ball struck the ground within 50 yards, rose again, and passed through the centre of the bull's eye. Even the following year, the prize medal was won by an individual, by mere chance. It was not, until some one, more inquisitive than the rest, learnt the advantage of having a ball to fit the bore. Since then the best shot has invariably got the medal; thus showing the advantage that must arise from having, for military purposes, as perfect a firelock as can be constructed.

When men possess no knowledge of themselves, it should be provided for them. Why do we boast of the perfection of our muskets? Can they be perfect, and yet not throw a ball 130 yards without elevation, while we possess guns

that will throw 230 yards under the same circumstances? We may excel other nations, but our ambition should prompt us not only to excel other nations, but to attain still greater excellence in the character of our arms. I consider it to be the first duty of every government to provide the best arms possible, for the defence of liberty and the repelling of aggression, that can be manufactured. That we can manufacture a superior gun I am convinced, and I trust, will be able to show. I have shown, that Mons. Dupin's opinion in the musket may be correct, according to mathematical principles, but certainly not on practical. I again assert, that for obtaining long ranges, (and that must naturally be the intention of all small arms, there being no ships' sides to be beat in with musketry, the only intention of which is the destruction of human life or limb,) the French musket is better calculated than the English; and had the French soldiers possessed the knowledge and skill to use it, they could have annoyed the English, during the late wars, in a way that our men could not have returned. There must always be a great advantage on the side of that army which possesses the means of carrying destruction into the ranks of the enemy at a distance, where he cannot return the compliment. But, to be sure, had we learned our soldiers these skulking habits of killing without being killed, they might have got cowardly; therefore, we prefer a fair field and

no favour. I am inclined to think, however, that other nations might not be actuated by the same spirit; in fact, the Americans gave us a specimen of playing at long bowls to our cost, both with the rifle and their naval artillery. I would, then say, as we are the manufacturers of arms for half the world, let us have as good or better, for ourselves than we furnish to our neighbours, and not make good the old adage, "A shoemaker always goes worst shod." For this purpose I will endeavour to point out some more of the defects of our present fire-arms, with a view to their improvement.

Another observation, and I will dismiss this part of the subject. It is said, that during an engagement, the musket gets so foul that she could not be loaded, without so much windage. This may be correct; but I have conversed with many veterans, who passed through the whole of the campaigns on the Peninsula, and I have never met with one who ever experienced such a difficulty; on the contrary, it seems to have been the general practice, during the heat of an engagement, to slip the cartridge into the muzzle, stamp the butt of the gun on the earth, and the cartridge was home. But, even did this evil exist to such an extent as to require such windage, do we possess no mechanical means of removing the foulness? Could not a species of wadding be introduced into the

cartridge, which would remove every particle of dirt left from the former discharge?

I would here recommend Walker's metallic, or a similar wadding; but then an improvement in the make of gunpowder might make even that unnecessary. Our Government just now evinces a disposition to alter the mode of firing musketry from the flint-lock to the percussion; they are, however, proceeding in such a way as to require no prophet to tell that it can never be satisfactory. In the first place, they are altering the old muskets in as bungling a way as was ever contemplated. I would ask, has not the experience of 50 years shown the superiority of the patent breech? Is it not capable of generating greater force in less time than the common plug? Does it not give greater force to the projectile, with a less charge of powder? Is not the recoil less to the shooter? Are not these advantages, not to speak of others, sufficient to induce its adoption? Why not give both the state and the soldier the benefit of such an improvement? The present method adopted, is simply welding on to the old barrel, above the touch-hole, a piece of iron, sufficiently large, to project to a level with the lock-plate, which, after cutting away the pan, is jointed under it, and the nipple is then inserted into this patch of iron; a hole is drilled in a cross direction, at the bottom of the screw into the barrel, a cock fit on to the

tumbler, and you have the alteration before you. Miss-fires will undoubtedly occur by this clumsy alteration, which would not be the case, were it a little more perfect, or had it the benefit of the patent breech.

At Woolwich I attended several of the practices of the battalion, to whom they were first entrusted for trial, and nineteen out of twenty miss-fires were entirely occasioned by the powder not getting up the nipple, from the sudden angles it had to pass, and the inability of the percussion-power to ignite it at that distance. This would rarely be the case with a gun patent-breeched, on my plan, tapering or expanding from the top of the interior of the nipple to the barrel. There is then no angles; and the chances of the powder coming up to the nipple is five to one over the other patched piece of work. Another reason exists why it is not calculated to be certain fire—in a fowling-piece the wadding, while being driven down the barrel, tends to drive the powder up by the air pressing upon it to the extremity of the breech or nipple. This is not the case with the musket; the cartridge fits too loose to lend the least assistance; and even if it were, so many angles would make it quite uncertain. Another objection to the alteration of the old lock is, the old locks are not calculated to suit percussion. It is not a heavy blow that will create detonation, but a sharp one. I have seen some hundred-

weight of iron laid upon a quantity of percussion-powder, which failed in igniting it, while a blow of less than ten pounds weight did so effectually. They are made with too much friction in their movements; the hooked mainspring itself creates too much, and destroys by its friction its own strength; and should the hook of the tumbler, by any neglect, be left without oil, or the case-hardening get worn off it, the lock will fail in creating a detonation nine times out of ten. This would be a pretty state to be in during an engagement!

If percussion is to be adopted, (and that it will be so, sooner or later, I have not the least doubt,) it must be after the following method. The barrel must be patent breeched, and cupped with a chamber as much of a conical nature, or of the shape of a half-parabolic spindle, as can be obtained, both because it shoots stronger, and the powder is more likely to get to the top of the nipple. It should also have the benefit of a loose or slip breech, technically termed a false breech, which is now used in nearly all fowling-pieces. It should also, instead of being fastened to the barrel by wire pins, have in their place bolts, which are now adopted in serjeant's carbines. For this reason, percussion-guns require to be oftener and more carefully washed than flint, to keep the nipple clean. It cannot be done, or it is not likely it will be so, if the same trouble and danger of breaking pins, or sometimes the

fore-part of the stock, exist as at present, which often costs the soldier more than he can afford to pay. These can be easier removed, and with less danger, than by the old rude method. The lock, too, should have the benefit of steel tumblers, and scear, and swivel main-spring; for, independent of the less friction attending locks of this description, they will undoubtedly wear much longer, and if so, must be beneficial to all parties. The form of lock, stock, barrel, or mounting, I will leave to be settled by military men; but I do say, to a percussion-musket, with the benefit of these improvements, give a trial before the fiat of rejecting them is pronounced, if such should be the opinion of the committee appointed to decide on its merits It may be said, the cost of a musket of this description would be great; I should think not. Such a musket, if I may be allowed to hazard an opinion, might be got up, at the present time, with these improvements, something under thirty shillings; and I believe the majority of our present stock cost that, or nearly that, and in some instances more, including the bayonet.

I will just say a few words on the mode of proceeding with the manufacture, and then proceed to make a few remarks on the lesser description of fire-arms. A few years ago, the skelps, or pieces of iron from which musket barrels were forged, were entirely forged by hand. A contract which some of the masters

obtained, induced the men in this branch to strike for higher wages than the terms of the contract would allow the masters to give without being themselves losers by the bargain. They were compelled to set their inventive powers to work, and, as it is truly said, necessity is the mother of invention, they succeeded in producing skelps in the following way. To be more explicit, I will take Mr. Babbage's description of a skelp. "A skelp is a piece or bar of iron about 3 feet long and 4 inches wide, thicker and broader at one end than at the other." The barrel of a musket is forged from one of these pieces, by folding or bending it round in a cylindrical form, until the edges overlap, so that they can be welded together. These skelps are rolled out, instead of being forged by hammers. Rollers, equal in circumference to the length of a barrel, are grooved with grooves cut wider and deeper from a point in the roller, until they return to the same point. Thus the bar, that has passed through these rollers, has the form wanted. Thence arises an immense saving in the manufacture of 100,000 stand of arms. At that time there did not arise any immediate necessity for further improvement in the same way, so that musket barrels continued to be welded by hand the same way as I described the welding of common barrels for the American trade, except in one piece instead of two. Some years after, these musket barrel-welders thought

they had sufficient cause for a strike; necessity again came into play, and invented, or rather improved a plan, for which a patent had been taken out some years before. The process consisted in turning a bar of iron a foot long into the form of a cylinder, with the edges overlapping each other. It is then placed in an air furnace, raised to a welding heat, taken out, a mandril or cylinder of iron passed quickly into the inside, and then introduced into a pair of rollers, having taper grooves the same in shape as a musket barrel. The effect of this is the perfecting of the welding in one heat. The remainder of the elongation is obtained by passing it repeatedly through the rollers until it becomes the proper length, but at a decreased temperature. This process is calculated to benefit the iron, by compressing the pores, if due attention is paid to let the heat be less every time it is passed through. Now I am speaking of forging: as it has been customary, with the fibres of the metal running parallel with the bore, or what are generally called common iron barrels, why, I ask, should not the military have the benefit of the twist barrel? Their limbs are as dear to them as any other person, and certainly the cost would not be a great deal more. I trust no one for a moment would class them with the latter, nor be found to advocate, save on the score of cost, their rejection. The welding of twist barrels in this way could not be effected,

as they require nearly as much pressure from each end as on the outside of the tube.

I may here be allowed to mention this, as an instance in which, by the effect of tyranny, an invention was productive of the greatest injury to the inventor. As soon as this method of welding musket barrels came into use, a combination was entered into, by all the barrel welders in Birmingham and the neighbourhood, not to work any of the inventor's iron (he was also a gun barrel iron forger, the late Mr. Clive) for any master whatever.

I need not tell any one acquainted with Birmingham, this resolution was most rigidly adhered to, and is yet, I believe. In fact, had any of the forgers been known to use his iron, I have no hesitation in saying their houses would soon have been too hot to hold them. The upshot of this was, no doubt, the means of depriving society of a talented member sooner than nature might have done.

Musket barrels are bored in the same manner as any other barrels, but by more rapid means. They are then sent to the grinding-mill, and reduced to the size wanted, after which they are breeched with the breech intended for them. A hole is drilled, which generally answers for the touch-hole, and they are sent to the proof-house. If they stand proof, the studs through which the wire pins secure it in the stock are rivetted or dove-tailed into their places; a square

piece of iron is brazed on near the muzzle, to secure the bayonet when fixed, which also serves for a sight—and they are ready for stocking. The stocking department is divided into two divisions, the rough stocker, and the screwer together and finisher. The rough-stocker lets in the barrel and lock, and also, to use a technical term, rounds up the stock. The other lets the furniture in, screws the gun together, and finishes up the stock. These branches, as in fact, other departments of military gun-making, during the late war, were immensely profitable, many men making (when they had a stout youth or two to help them) from £7 to 8 per week; even the engravers, who merely engraved the lock-plate and cock, by putting on the crown G. R., the word *Tower* across the end, and what they termed threading them, reaped similar profits. Great is the alteration now: many of those who were termed military gun-makers do not earn more than that number of shillings.

They cry out now, "Verily, ye have turned your swords into ploughshares, and your spears into pruning-hooks!" A foreign order is now greedily snatched at, which before would not have been taken. Therefore, I would fain hope, that our rulers may be induced, if any alteration in the system of firing should be adopted generally, not to waste money by altering what is bad already, but to adopt a superior description of article. Though the outlay may be

inconvenient in these reforming times, yet it is sometimes ill saved. There cannot be a doubt, that were England to adopt a better and more effective musket, that many nations would be induced to follow her example, who would come to us as a market, and thus, what she had expended in being liberal to herself, would be returned in the prosperity of her merchants and artisans. No doubt, when they flourish, the mother nation of such a people must be great;—but stop!—what have I to do with politica economy? had I the powers of Harriet Martineau I might enlarge on this subject!

I before touched on the prospect of rifles becoming more generally used for military purposes, and, as that matter is in the press, while I write this, I will here take the liberty of suggesting a species of fire-arms partaking of each without the objections applying to either.

I mean a sort of rascally plan adopted a few years ago of what was termed *scratch rifling duelling pistols*. In these pistols, the grooves were not deeper than the thickness of a piece of writing paper, but there was a great quantity of them, and having the spiral direction, they were quite capable of giving to the ball fired from them, nearly all the rotatory motion required. Now, could they not be adopted in musketry? It would be decidedly preferable to no rifling. Besides, there would be another advantage. All barrels for throwing balls, are better, if polished

lengthways instead of circularly; for then the ball meets with less resistance from friction. A barrel thus polished, will shoot 20 shots more without becoming so foul as a barrel bored spherically, and that not often being particularly fine bored.

In fact, in all guns I ever made for shooting ball, or what is termed smooth-bored prize guns, I found it an advantage to polish them lengthways, until the whole of the circular marks were obliterated. They shot much better; kept longer clean; and were less liable to recoil. By the bye, another material fault exists in the musket, which had nearly escaped my observation. Accuracy in ball-shooting can never be obtained, where there exists any recoil from the explosion; therefore, all barrels intended for that purpose, should be as heavy as they can be made, consistently with the convenience of the soldier.

The English musket is much too light in the barrel, for correct shooting. If we take the weight of the barrel as it is at present, it should not have a bore of above ,623 diameter, or a ball 20 to the pound, to be capable of in any way destroying or resisting the recoil from the explosion. The lock is nearly half a pound heavier than there is any occasion for whatever; the brass mounting a full quarter of a pound, the stock another half pound, making a pound and a quarter; which might be very beneficially added to the weight of the barrel, the size of bore it is.

Did the musket shoot even moderately well, that obstruction placed to secure the bayonet, (*called the sight*) completely prevents the soldier obtaining any thing like a direct sight. It might be placed on the side of the barrel, to answer the purpose quite as well, and a small sight placed below the point to where the socket of the bayonet reaches. Several of the light horse regiments, some years ago, were furnished with rifle carbines. The idea was excellent, but the same error seems to have been fallen into with all. They were too large in the bore for their length, as well as too light in the barrel for the size of bore. The cartridges made for them, possessed or allowed too much windage. The rifling was of little use, for the cartridges never fit the grooves at all. Several of the heavy dragoons are armed with carbines, musket bore, for the advantage of having musket cartridges. The idea is ridiculous. They will not, though fired from horseback, throw a ball with certainty, above 50 yards. All guns, short in the barrel, should have a bore in proportion.

I have shown that a small rifle, only 18 inches in length, and 32 bore, with ¼ of a musket charge of powder, will give above a musket's range. Then in carbines, of all guns, you do not expect a long range, nor care about the deflection of the ball by the wind. Why adopt so large a bore, if your dragoon, when not otherwise wanted, could sit on horseback, and annoy an enemy at 15

yards, with a carbine even of a bore of 20 balls to the pound, while the one he has at present, is useless at a distance exceeding 40 yards ? Would not this, I ask, be a benefit worth having ? Again, the pistols of heavy dragoons, are musket bore. A soldier, firing from horseback, receives from a pistol of this bore such a recoil, as totally to prevent him taking any sort of aim whatever, without he can place it to the breast of his enemy. In many instances, the result, as I have experienced, is so great, as to benumb the arm very much. Were these pistols made of a bore corresponding to the length, they might be a destructive weapon; as a man, with moderate skill, could destroy an enemy at a distance of from 25 to 30 yards. As it is now, he must have the muzzle to the breast, if he hits above once out of ten times. All military arms seem to be made on mathematical principles. Every thing is sacrificed to great weight of projectile, as if a ball, 100 to the pound would not destroy human life quite as effectually as a ball ten to the pound. I should say, that military men, (with all due respect to their character as military men,) are not exactly the men to judge of the best sort of arms for military purposes. Many of them, I know, understand artillery as well as any men in the world, but they seldom think it worth their while to descend to bestow their talents on the humble musket; hence its neglected state. I have thrown out these obser-

vations, as they have occurred to me. I do not boast of extensive practice with military fire-arms; but, while I admit this, I must say, that the observations I have made, bear the impress of reason and truth more strongly than any I have beard as yet advanced. A portion of them may be wrong. If so, I trust that the reader who can confute them, will be generous enough to do so in the same spirit in which I have attempted to establish their truth. I now take leave of the reader, with many thanks for his attention; and should the humble opinions advanced throughout the course of this work, meet with the approval of the public, I hope to meet him again in a more extended shape. For I need not remind him, when a work is successful in a first edition, plenty are to be found to assist him in forming a second.

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